Piney Branch Special Protection Area

4.3.1 Description of the Piney Branch SPA Watershed

The Piney Branch watershed was designated as an SPA because of the intensive development planned for the area and the existing high water quality found in the watershed. SPA designation was done by County Council resolution on October 24, 1995. The Piney Branch watershed, a subwatershed of Watts Branch, is located in south-central Montgomery County just west of the city of Rockville (Figure 44). Piney Branch originates just to the north of Shady Grove Rd. and east of Travilah Road. From its headwaters, Piney Branch flows to the south entering Watts Branch just south of Glen Road. The SPA includes all 2400 acres of the Piney Branch watershed.

Prior to 1990, the Piney Branch watershed consisted of a mix of agricultural land uses and large lot (1-2 acre) single family homes with some commercial and office development. In early 1993, residential construction began in the headwaters area of Piney Branch on the Willows of Potomac and Piney Glen Village, two large residential subdivisions. No SPA requirements were placed on these projects as they predated the SPA designation. In mid 1994, construction began in the Piney Branch stream valley on a sanitary sewer line from the Watts Branch up to the headwaters of Piney Branch.

4.3.2 Status of Development in Piney Branch SPA as of June 2003

Twenty-one final water quality plans have been approved for this SPA (Table 19). There are several other projects in various stages of the planning and development process. Also, a significant amount of development had been approved prior to SPA designation. There is potential for adverse change to Piney Branch due to the cumulative impacts of these projects. This is being mitigated on projects currently under construction by strict adherence to approved standards and by innovative stormwater management techniques. All new development will have to adhere to more stringent SPA requirements.

Although the Piney Branch watershed has experienced an increase in development activity over the last couple of years, the majority of the proposed development is for large residential single family lots (0.5 acres to 2+ acres). One notable exception is the Traville site. This site is 192 acres of proposed mixed-use development within the headwaters of the Piney Branch. The site is made up of six separate site plans (and six interconnected Final Water Quality Plans), with three of the site plans currently under construction and the three others nearing permit approval. It is expected that with this amount of construction activity that there may be some initial water quality impacts however, by using the oversized and redundant sediment trapping devices that were required these impacts should be kept to a minimum.

The planned Traville development includes a retail center, apartment buildings for elderly living, various multi-family dwelling units, a research and development campus for Human Genome Sciences and additional research and development areas for future development. This project will present a

considerable challenge in maintaining water quality after construction is complete due to the inherently high percentage of impervious area that accompanies this type of development. The developers of Traville had originally agreed to limit the overall site imperviousness area to 35%, however that number was subsequently reduced to about 33%. This percentage may still appear to be somewhat high, but it reflects a significant reduction in imperviousness than what would normally be seen in this type of development. This reduction in imperviousness along with the redundant water quality BMPs (treating the first 1 inch of runoff from the impervious areas), expanded stream buffers and quantity control for the 1-year storm, will afford the best opportunity to mitigate the potential impacts of this development. It will be quite interesting to monitor the extensive and complex web of the interconnected BMPs on this site however, it could be some time (one to two years) before the BMPs are converted from temporary sediment control to permanent stormwater management at which time post development monitoring will begin.

As a separate initiative, DEP is also investigating other opportunities for improving existing stormwater management controls in the watershed through the Montgomery County Stormwater Management Capital Improvement Program (CIP). DEP has completed a study of the drainage area on the University of Maryland Shady Grove campus. This study investigated possible improvements to the existing SWM pond and stream valley upstream of the pond. These improvements consist of combinations of wetland enhancements, reforestation, and bank stabilization. Results of the study are now being reviewed by DEP. DEP has also met with the property owner, who has agreed, in principle, to participate in improvements on the property.

DEP has also worked cooperatively with the M-NCPPC to evaluate stream conditions and erosion problem areas throughout the Watts Branch watershed including Piney Branch. In 2002 DEP initiated a study of the Watts Branch watershed including the Piney Branch SPA. The scope of the study is to evaluate and rank subwatersheds based on stream bank erosion, aquatic habitat conditions and other factors affecting stream stability. The study will identify and prioritize restoration projects including new or improved stormwater controls, stream restoration and smaller volunteer projects. Concept designs will be developed for the highest ranked projects. The study is scheduled for completion in the summer of 2004.

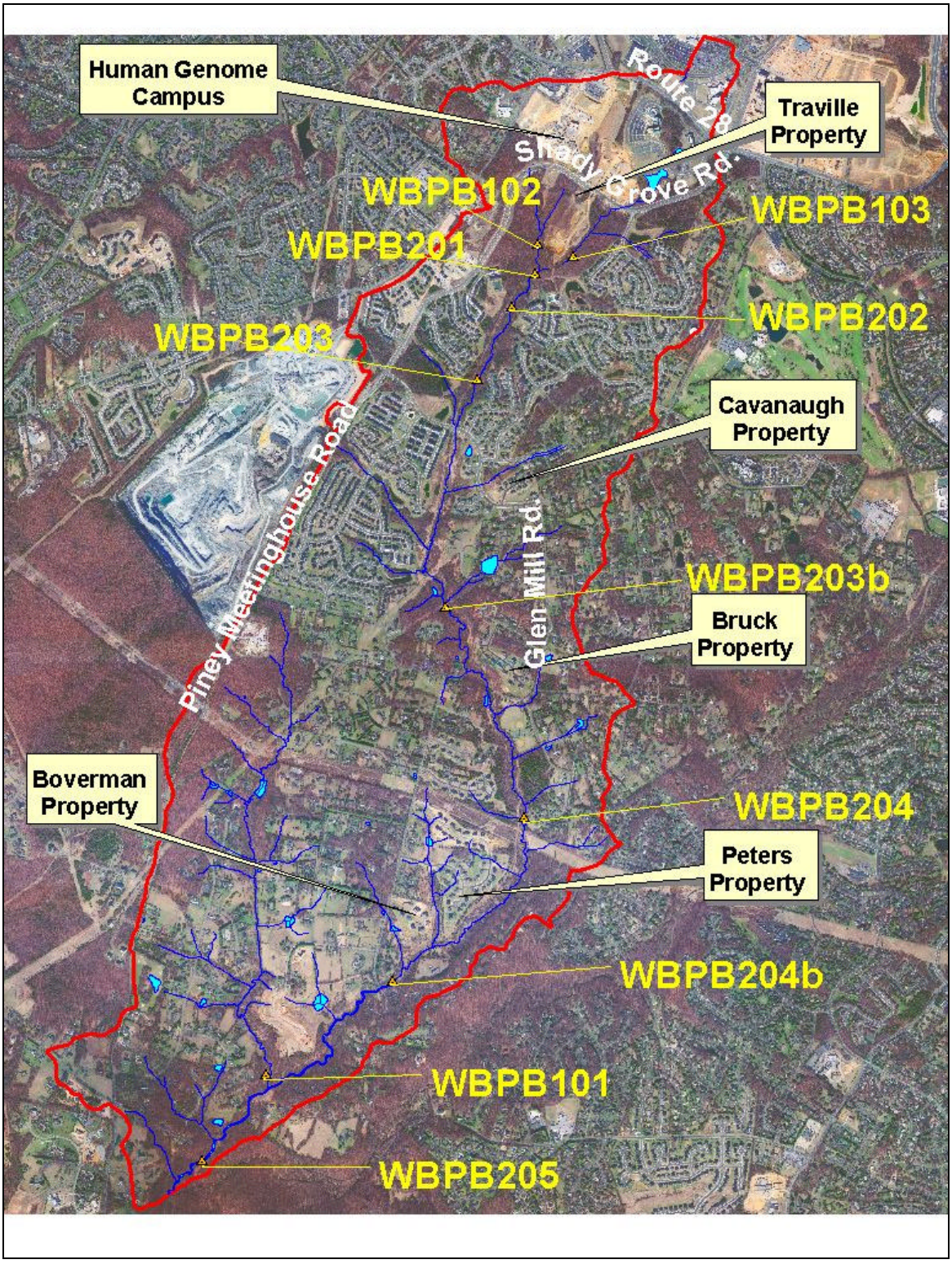

Figure 44 Piney Branch Special Protection Area Delineated in Red - Orange Triangles Are Stream Monitoring Locations, Labeled Properties Are New Development Projects Submitting BMP Monitoring Data.

Table 19 Piney Branch SPA Development Projects (1995 to June 2003)

PROJECT NAME	SPA LOCATION	DEVELOPMENT SIZE, TYPE	STATUS
Avon Glen	Piney Branch - middle reach	39.6 acres, RE-1 28 lots and sewer pumping station	Subdivision approval predated SPA designation. Construction complete.
Boverman Property	Piney Branch - Lower reach	13.8 acres, RE-1	Construction complete.
Bruck Property	Piney Branch - Lower Reach	16 acres, RE-1	Construction complete.
Burton Glen	Piney Branch-Lower reach	3.3 acres, 3lots	Water quality inventory approved.
Carb 2	Piney Branch headwaters	1.7 acres, R&D	Preliminary and final water quality plan approved.
Cavanaugh Property	Piney Branch – middle reach	18.1 acres, RE-1 Cluster, 18 lots	Construction complete.
Charles Duvall Farm	Piney Branch	0.5 acres, R-200 1 lot	Exempt from SPA Water Quality Plan Requirements.
Glen Mill Knolls	Piney Branch-Lower reach	4.13 acres, RE-1, 1 lot	Water quality inventory approved.
Grupenfoff Residence	Piney Branch	2 acres, 1 lot	Exempt from SPA Water Quality Requirements.
Hoffman Property	Piney Branch	10.26 acres, RE-1, 1 lot	Preliminary and final water quality plan approved. Under construction.
Horizon Hills	Piney Branch-Lower reach	4.0 acres, RE-2	Water quality inventory approved. Sediment control permit pending.
Hunting Hill Woods	Headwaters	1.6 acres, R-200, 3 lots	Water quality inventory approved. Sediment control permit pending.
Lakewood Glen	Piney Branch	5.2 acres, RE-1 5 lots proposed	Exempt from water quality plan requirements.
Lankler Property (Highgate)	Piney Branch-Lower reach	60.3 acres, RE-2	Water quality inventory approved. Under construction.
New Life Christian Fellowship Church	Piney Branch – Headwater area	1.2 acres, Proposed church	Pre-application meeting complete. On hold.

Table 19. (continued)

PROJECT NAME	SPA LOCATION	DEVELOPMENT SIZE, TYPE	STATUS
North Glen Hills	Piney Branch-middle reach	2.26 acres, RE-1, 2lots.	Preliminary and final water quality plan approved. Under construction.
Otsuka America Pharmaceutical, Inc.	Piney Branch – Headwaters	4.7 acres, R&D	Preliminary/final water quality plans approved. Construction complete.
Peters Property	Piney Branch-Lower reach	RE-1, Cluster Option	Construction complete. As-built under review.
Piney Glen Village	Piney Branch – Middle reach	188 acres, Mixed residential	Some of the project predates SPA requirements. Sediment control permits issued. Under construction.
Piney Meetinghouse Road and Travillah Road Improvements	Piney Branch-Middle reach	Road Improvements	Preliminary/final water quality plans approved. Sediment control permit issued.
Piney Meetinghouse Road Site - Fling Property	Piney Branch – Middle reach	6.4 acres, RE-2, proposed mulching/ landscape operation	Preliminary/final water quality plans approved. Pending special exception.
Potomac Glen South	Piney Branch	15.3 acres, RE-1 8 lots proposed	Exempt from water quality plan requirements due to low imperviousness. Construction complete.
Shady Grove Adventist Hospital Addition	Piney Branch – Headwaters	4.8 acres	Preliminary/final water quality plans under review.
Shady Grove Life Sciences Center – Life Technologies Inc.	Piney Branch – Headwaters	18.1 acres – R & D	Preliminary plan approved prior to SPA designation; however, voluntary compliance. Water quality plans approved. Initial construction complete.

Table 19. (continued)

PROJECT NAME	SPA LOCATION	DEVELOPMENT SIZE, TYPE	STATUS
Shady Grove Road	Piney Branch – Headwaters	8 acres, Road extension	Construction is complete. Awaiting as-built approvals.
Simmons Property	Piney Branch	2.1 acres, 4 lots R-200/TDR	Water quality inventory approved.
Snider Property	Piney Branch – Lower Reach	21.9 acres, RE-1C	Construction complete.
Temple Beth Ami	Piney Branch – Headwaters	7.9 acres, R-200 TDR Church	Preliminary and final water quality plans approved. Construction is complete. Permit closed.
Tenny Property	Piney Branch	2.5 acres, R-200 5 lots	Exempt from water quality plan requirements.
Travilah Road Project	Piney Branch	9.0 acres, Road improvements	Preliminary/final water quality plans under review.
Traville (5 Site Plans) 1) Senior Housing (sediment control plan pending) 2) Retail Center (under construction) 3) Village Center Streets (under construction) 4) Avalon Bay (sediment control plan pending) 5) Human Genome Sciences (under construction) 6) Parcels I, J and K	Piney Branch – Headwaters	192 acres, MXN and R&D (there are two additional R&D sites that will be developed in the future)	Preliminary water quality plan approved for the entire site. Separate final water quality plans have been approved.
Willow Oaks	Piney Branch-Middle reach	5.5acres, R-200	Preliminary/final water quality plan approved. Under construction.

Table 19. (continued)

PROJECT NAME	SPA LOCATION	DEVELOPMENT SIZE, TYPE	STATUS
Willows of Potomac	Piney Branch – Middle reach	245 acres, mixed residential	Subdivision approvals predate SPA requirements. Sediment control permits issued. Construction complete.
Wilson Property	Piney Branch-Lower reach	10.3 acres, RE-2	Pre-application meeting complete.

4.3.3 Summary of Environmental Protection and Innovative Site Design: The Revised Traville Concept for Consolidation of Human Genome Sciences

The Traville project at the headwaters of the Piney Branch continues to provide many challenges in the effort to achieve a successful combination of development and water quality/environmental protection. However, recent changes to the concept for the largest Research and Development (R&D) portion (with Human Genome Sciences as the principal tenant) reflect achievement of many environmental objectives of the Special Protection Area program.

The water quality plan includes standard SPA elements such as SWM features in series, protection and enhancement of environmental buffers and the natural resources within them, including full reforestation of all unforested portions of the stream valley buffer which will be permanently protected through Category I Forest Conservation Easements. The concept also proposes use of many site design elements to reduce environmental impacts of the development on Piney Branch, within the framework of master planned land uses and zoning. These elements include: use of taller buildings, internal garages, and structured parking leading to lower impervious cover; greater open space leading to enhanced opportunities for more gentle, natural appearing, aesthetic multi-use recharge/infiltration/ water quality treatment facilities (including two volleyball courts within a sand filter); flexibility in the location of the edge of grading resulting in better achievement of environmental and development objectives; and more opportunity for appropriate transitions between natural and developed areas. Further design enhancements serving multiple objectives are still being considered.

4.3.4 Summary of BMP Monitoring in Piney Branch

Eight development projects in the Piney Branch SPA are now required to do BMP monitoring (Table 17). Five of these have completed construction and are now submitting post-development monitoring data. These five include Shady Grove Road, Cavanaugh Property, Bruck Property, Boverman Property and Peters Property. Analysis of the BMP monitoring results from these five projects is included in the following sections. The other three projects, Traville, Snider and Willow Oaks are currently under construction and it is too early to draw conclusions on BMP performance from these sites. Once we get post-construction data from these sites we will be able to compare it to pre-construction conditions.

Table 17 Piney Branch BMP Monitoring

PROJECT NAME & CONSULTANT CONDUCTING THE MONITORING	REQUIRED BMP MONITORING	REQUIRED TIME FRAME FOR BMP MONITORING	DATA SUBMITTED THUS FAR
Shady Grove Road / Loiderman Assoc. ***(construction completed during summer of 2000)***	**4 turbidity stations** **4 embeddedness stations**	**pre-development monitoring:** 1 year **during-development monitoring:** until site is stabilized and sediment control structures converted to water quality **post-development monitoring:** min. 3 years	**turbidity data:** 4/97 - 12/02 **embeddedness data:** 4/97 - 12/02
Traville / Loiderman Assoc. Includes the Human Genome Sciences, Gateway Streets, Senior Housing, Traville Village Center (Beatty), and Avalon Bay projects ***(construction began 1/02)***	**2 continuous temperature loggers** **groundwater monitoring wells** *water level* **1 continuous flow logger** **3 Cross sections** **Surface water storm samples** **embeddedness** **Stormwater samples from sediment ponds** **Infiltration structure percolation rates**	**pre-development monitoring:** 1 year **during-development monitoring:** until site is stabilized and sediment control structures converted to water quality **post-development monitoring:** to be determined at final site plan approval.	**temperature data:** 6/97 - 9/97 6/98 - 9/98 6/99 - 9/99 6/01 – 9/01 **groundwater data:** 8/97 - 10/97 **flow data:** 8/97 - 10/97 Pre-construction requirements met ***construction began 1/02***
Bruck Property ***(construction complete)***	**2 continuous temperature loggers** **1 embeddedness station**	**pre-development monitoring:** 1 year **during-construction monitoring:** until site is stabilized and sediment control structures converted to water quality	**Temperature data:** 7/98 – 10/02 **embeddedness data:** 6/99, 12/99, 5/00, 9/00, 5/01, 10/01, 5/02, 10/02, 5/03

Table 17 Piney Branch BMP Monitoring (continued)

Boverman Property *(construction completed 5/02)*	**1 continuous temperature logger** **1 embeddedness station** **1 groundwater well:** *nitrate, nitrite, TKN,, total Phosphorus*	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 3 years	**temperature data:** 7/98 – 9/02 **embeddedness data:** 6/99, 12/00, 5/00, 9/00, 5/01, 10/01, 5/02, 10/02 **groundwater well data:** 6/99, 11/99, 1/00, 9/00, 5/01, 10/01, 5/02, 10/02
Cavanaugh Property *(construction completed)*	**3 continuous temperature loggers** **2 groundwater wells** **1 embeddedness station**	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 2 years	**temperature data:** 7/98 – 9/98 7/99 – 9/99 6/01 – 9/01 6/02-9/02 **groundwater data:** 3/98 – 5/01 Monitoring terminated by Consultant **embeddedness data:** 8/98 – 9/02
Peters Property *(Construction completed during fall of 2001)*	**2 continuous temperature loggers** **2 embeddedness stations** **1 continuous flow logger** **photo documentation of pond outfall condition**	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 2 years for photo documentation and 3 years for all other monitoring	**temperature data:** 4/99 – 10/99, 6/00 – 10/00, 6/01-9/01, 5/02 - 9/02 **embeddedness data:** 10/98 – 11/02 **flow data:** 2/00 – 5/02 **photo documentation:** 10/98 – 9/01
Snider Property *(Construction complete)*	**3 Surface water samples annually** (nitrate, nitrite, TKN, Total P, Ortho P, TSS) **Quarterly photo documentation of pond outfall condition**	**pre-development monitoring**: 3 water samples **during construction monitoring**: until site is stabilized and sediment control structures converted to water quality **post construction monitoring**: 3 years	**Surface water samples:** 8/00 – 10/01 **photo documentation:** 9/00 – 10/01
Willow Oaks *(construction began 1/02)*	**TSS sampling of sediment pond during construction** **One-time pesticide sampling of runoff after mass application of termite repellent.** **Chemical and nutrient sampling of BMP**	**pre-development monitoring**: none **during construction monitoring**: until site is stabilized and sediment control structures converted to water quality **post construction monitoring**: 3 years	**No data submitted to date** **Samples could not be collected because site did not properly drain to pond**

Shady Grove Road (Post-construction)

BMP monitoring at the Shady Grove Road project includes turbidity measurements and embeddedness evaluations at four monitoring stations in upper Piney Branch. The project extends Shady Grove Road from Rt. 28 to Piney Meeting House Road. Construction began in May of 1998 and concluded in February of 2000. Two sediment control ponds were converted to storm water management facilities during the period of April – September of 2000 signifying the transition from during-construction monitoring to post-construction monitoring.

Turbidity and embeddedness monitoring is done upstream and downstream from each of the two stormwater management facilities. Monitoring stations 1 and 2 are located on the western tributary, upstream and downstream of pond 2. Monitoring stations 3 and 4 are located on the eastern tributary, upstream and downstream of water quality facility 6A (Figure 45).

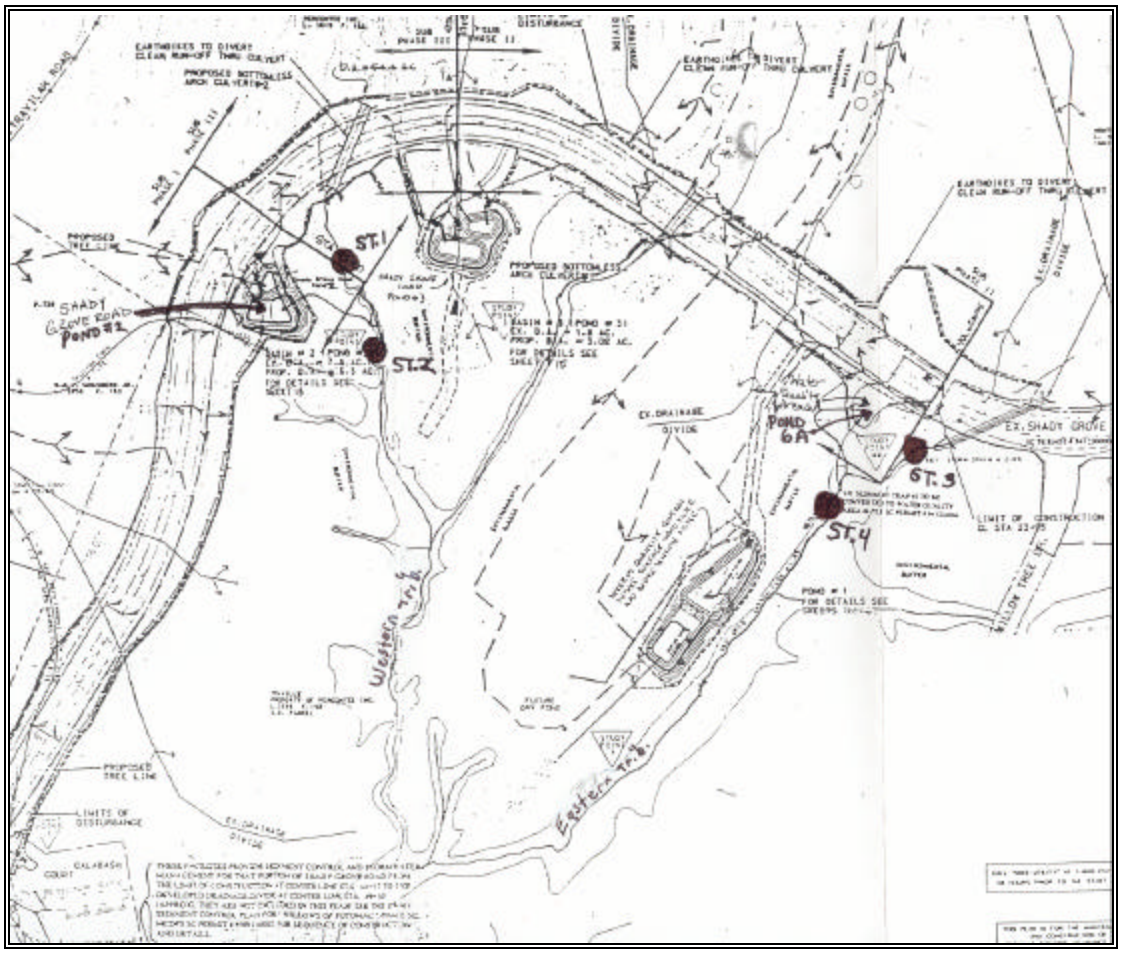

Figure 45 Site Map of Shady Grove Road Extended Construction Project

Turbidity readings are taken within 24 hours of a precipitation event. During the pre-construction period stream turbidity did not change drastically in the area where the pond 2 outfall was subsequently installed (Figure 46). During construction two precipitation events, 0.79 inches on 8/11/98* and 0.96 inches on 8/28/00*, caused large increases in turbidity in the stream. Turbidity was not greatly increased in this area following other monitored rain events during construction. Post-construction results show no increased stream turbidity in the area of the pond 2 outfall. These results suggest that, apart from big precipitation events, pond 2 was effective in minimizing stream turbidity increases during-construction.

* *Precipitation data from Colesville Maintenance Depot on Maydale Rd. (Colesville, MD)*

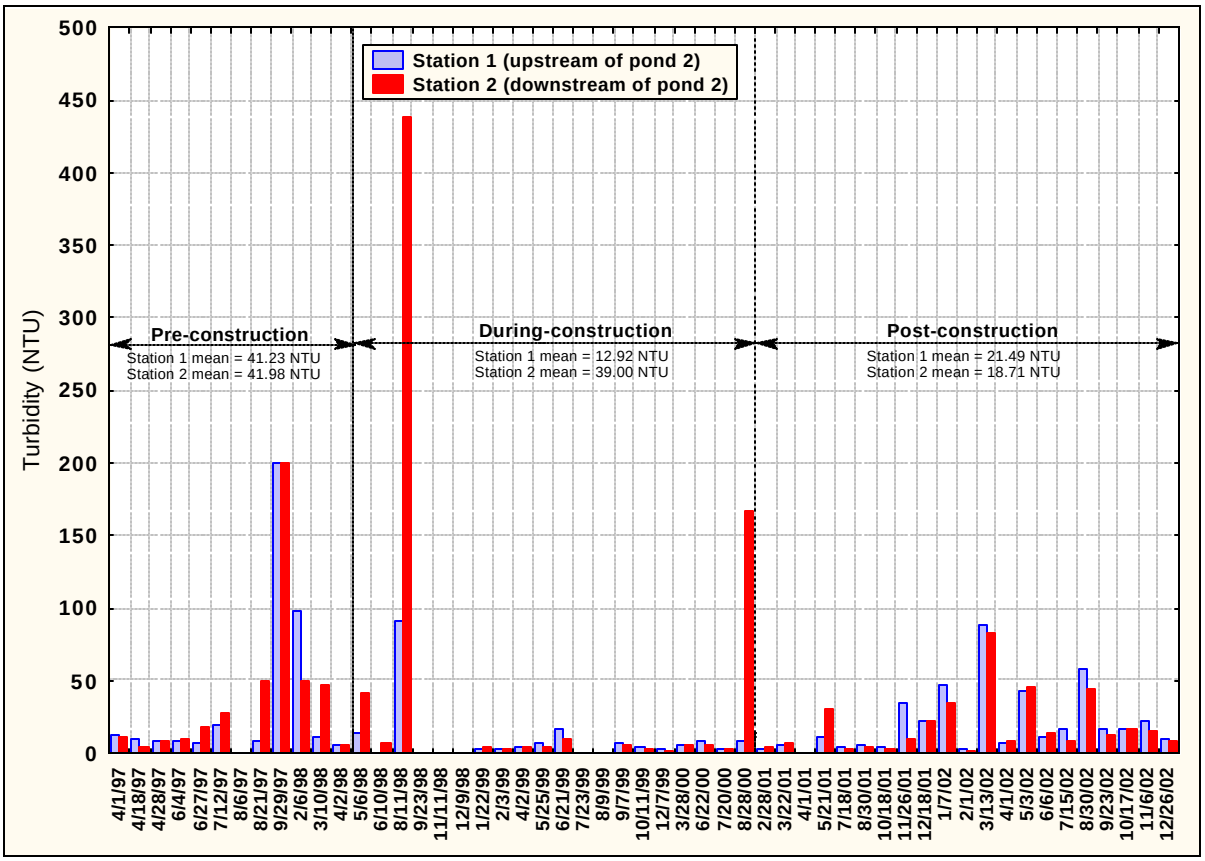

Figure 46 Turbidity Monitoring Results From Shady Grove Road - Pond 2

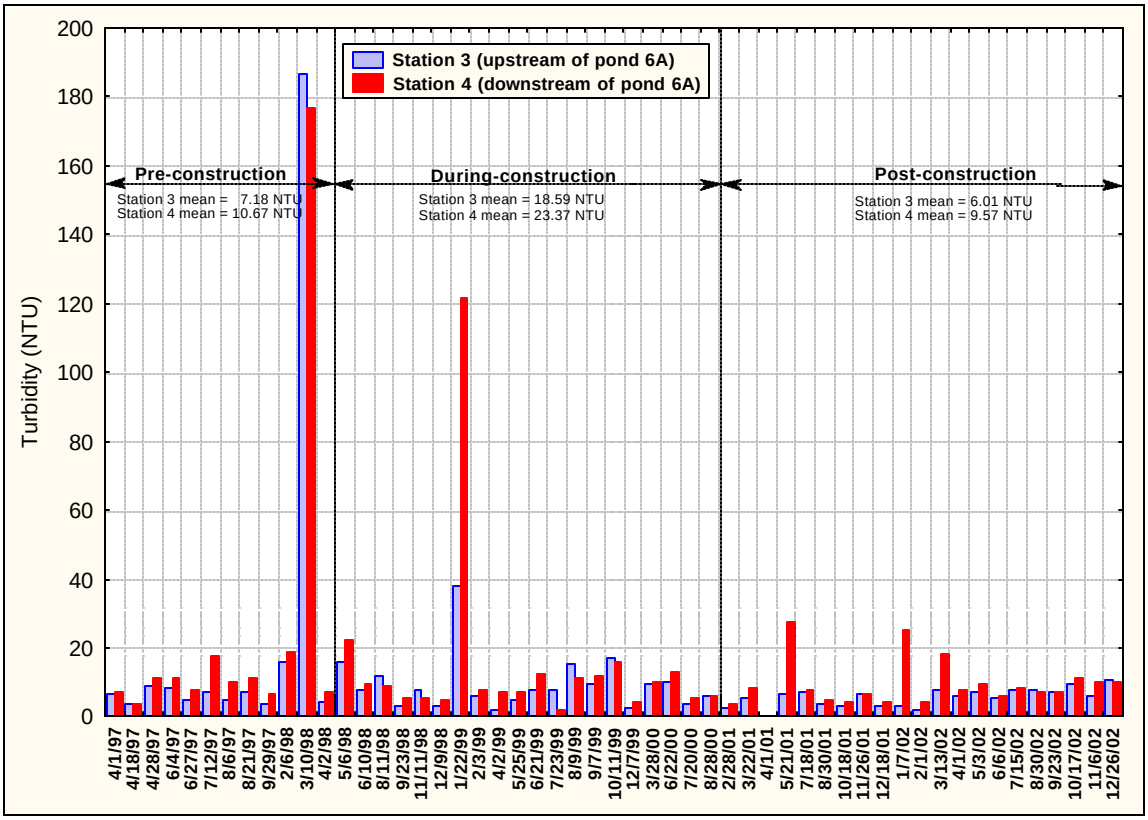

Figure 47 Turbidity Monitoring Results From Shady Grove Road - Pond 6A

At pond 6A, turbidity did not increase greatly in the location of the future outfall during the pre-construction period. During construction one storm event on 1/22/99 caused a large increase in stream turbidity in the vicinity of the pond 6A outfall. No other results obtained during construction indicate an impact on stream turbidity in this location. This indicates that pond 6A functioned well in preventing turbidity impacts during the construction of Shady Grove Road. After construction three events produced minor increases in stream turbidity in the area (5/21/01, 1/7/02 and 3/13/02). These increases were larger than increases seen prior to construction but far less than the increase seen on 1/22/99 during construction.

Embeddedness monitoring indicates that construction of Shady Grove Road did not cause long-term impacts to stream condition. A paired t-test found no significant differences ($p>0.05$) between the station upstream (#3) and downstream (#4) of the pond 6A outfall during the pre-construction, during-construction or post-construction periods. A paired t-test found that Station 2 below the outfall of pond 2 did have significantly higher embeddedness values than upstream station 1 during the pre-construction period ($p=0.04$). Once construction began this difference was no longer observed ($p=0.19$). During the post-construction period the two stations resumed their pre-construction relationship with the paired t-test indicating that downstream station 2 was more embedded than station 1 upstream ($p=0.02$). The difference between the two stations was similar in the pre-construction period (10.4%) to the post-

construction period (12.5%). This apparent change in the during-construction period could possibly be related to changes in flow or a reduction in sediment load caused by sediment control pond 2. Annual weather variation, in-stream road construction activity, or natural stream sediment dynamics could also be responsible for the apparent difference.

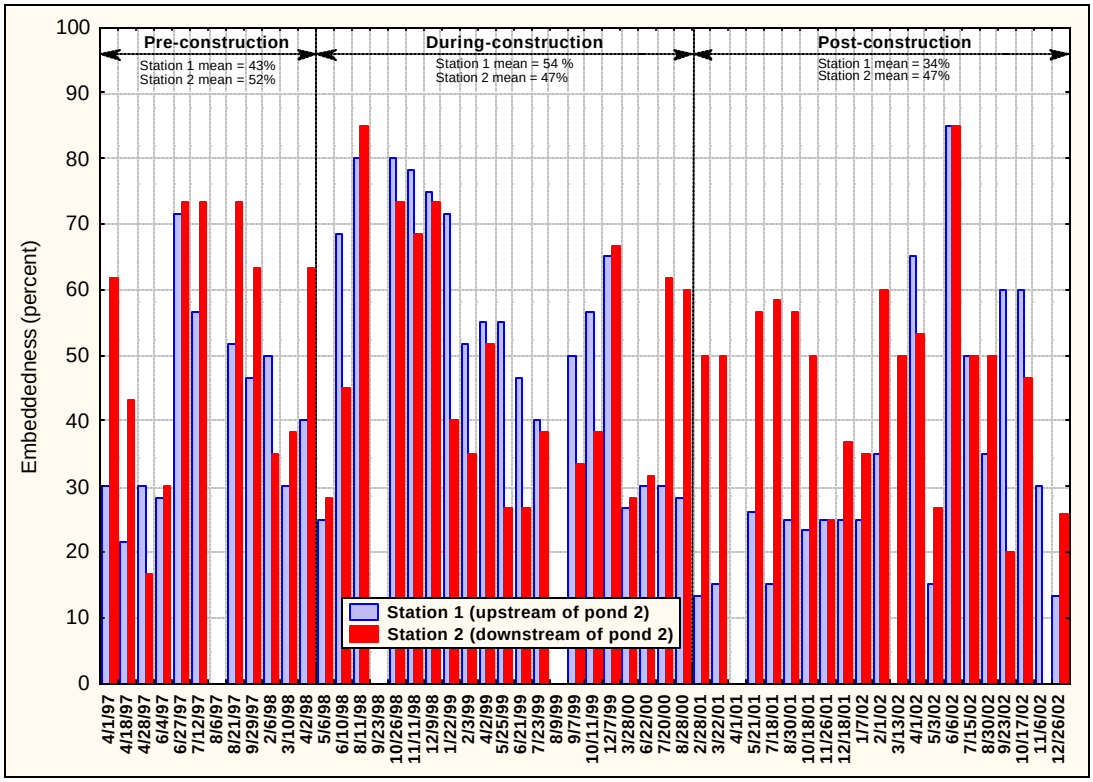

Figure 48 Embeddedness Monitoring Results From Shady Grove Road - Pond 2

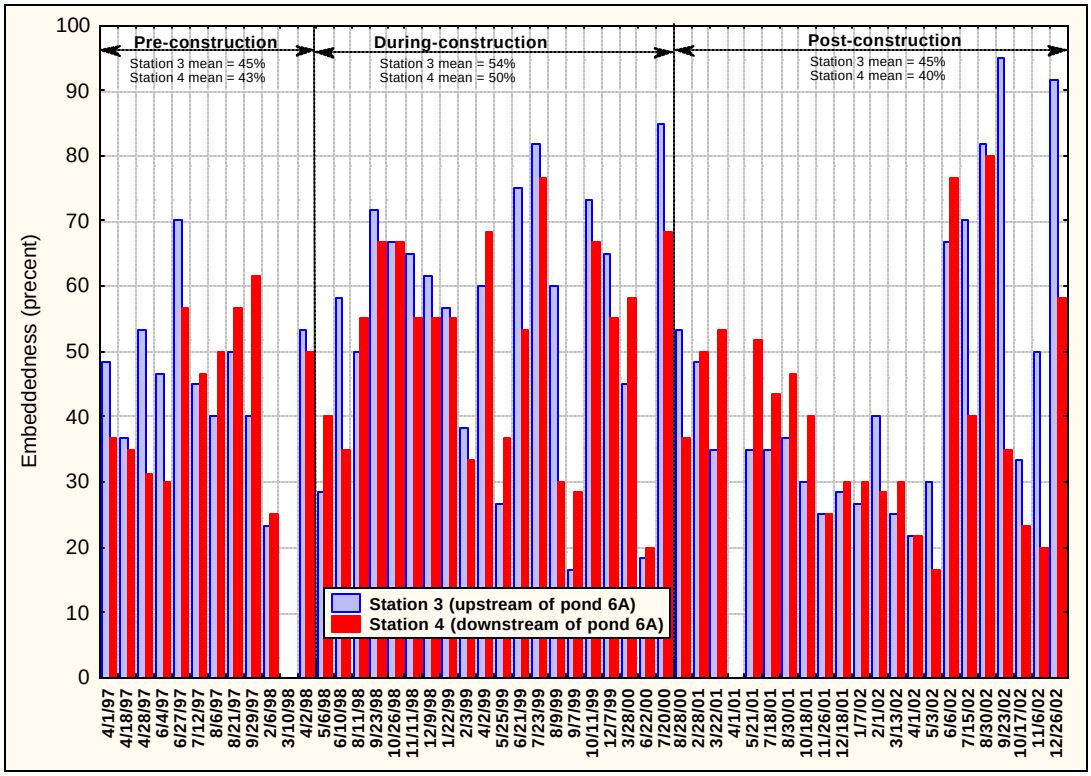

Figure 49 Embeddedness Monitoring Results From Shady Grove Road - Pond 6A

Bruck Property

The Bruck property is a 16 acre parcel of land (zoning is RE-1) located at the corner of Glen Mill Road and Burton Glen Drive. Piney Branch flows through the southwest corner of the property. Development of the property consists of 11 single-family homes and associated infrastructure. Water quality control consists of an infiltration trench sized to treat the first one inch of runoff. Vegetated road-side swales provide pre-treatment. Due to the relatively small percentage of imperviousness and the large water quality control structure, stream channel restoration was required in lieu of on-site water quantity control. The stream restoration includes biologs, rock stabilization and willow plantings on stream banks along the portion of Piney Branch that flows through the property.

BMP monitoring includes two continuous water temperature loggers and one stream habitat / embeddedness monitoring station. One temperature logger is placed near the western property line, the other at the southern property line where the stream exits the property. Habitat and embeddedness monitoring is done near the point that Piney Branch exits the property (Figure 50).

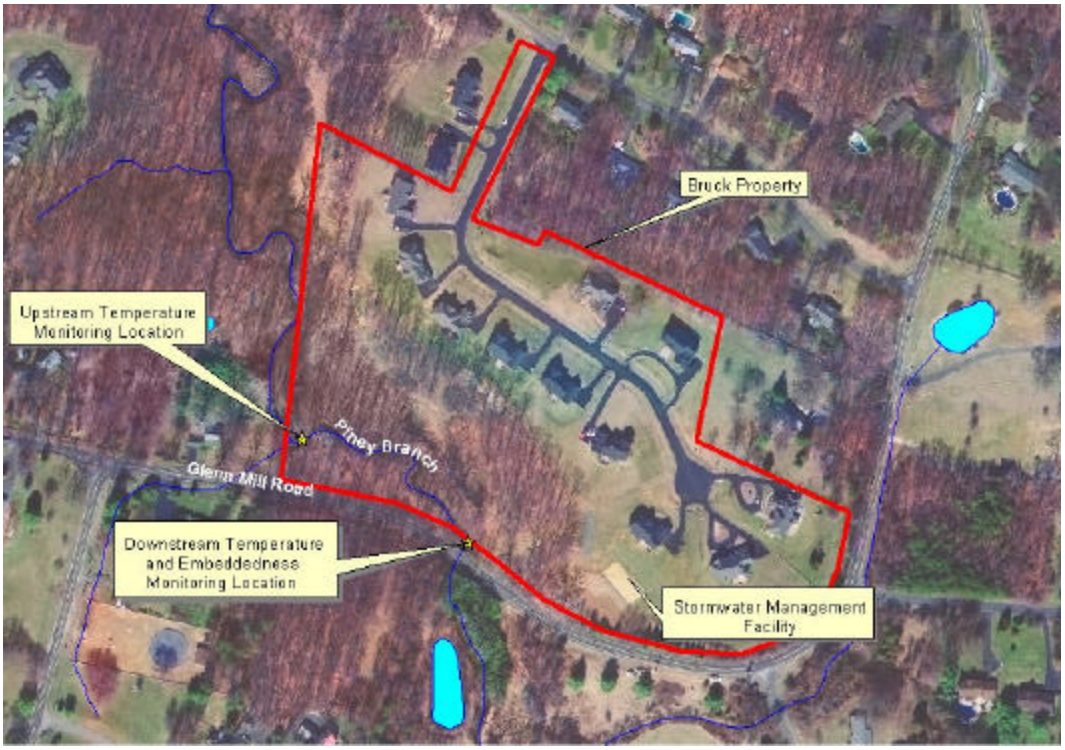

Figure 50 Aerial Photo of Bruck Property photo taken 12/02

Construction on the Bruck property began in August of 1999 and was completed in early 2001. Although temperature monitoring began in 1998, data was not reliable because the downstream logger recorded air temperatures. The logger was not placed in a deep enough location in the stream. Therefore, baseline pre-construction monitoring data is only available from June 1 – August 19 of 1999. Results of all temperature monitoring are summarized in Table 18.

Table 18 Summary of Water Temperature Data From Piney Branch - Upstream and Downstream of the Bruck Property (study period for each year is June 1 - August 19)

YEAR	LOCATION	N	MEAN (^{0}F)	MEDIAN (^{0}F)	MAX. (^{0}F)	STD. DEV.	DIFFERENCE (downstream – upstream)
1999 pre-construction	Upstream	960	68.7	69.7	76.7	3.8	1.8
	Downstream	960	70.5	71.3	79.6	4.1	
2000 during-construction	Upstream	800	69.1	69.4	76.7	3.3	0.3
	Downstream	800	69.4	69.4	77.4	3.6	
2001 post-construction	Upstream	800	67.9	68.2	74.0	2.9	1.3
	Downstream	800	69.2	69.4	78.1	3.8	
2002 post-construction	Upstream	4800	71.2	71.3	79.2	3.5	0.4
	Downstream	4800	71.6	71.8	79.4	3.7	

Mean water temperature for the period of June 1 – August 19 is slightly higher at the downstream station during each of the four years. Placement of the temperature loggers is the likely cause. The upstream logger is placed in a location that is well shaded while the downstream logger receives more solar radiation. The sun can also have a stronger effect on the downstream logger because it is in water that is about four inches deep at base flow while the upstream logger is about twelve inches below the surface at baseflow. Average difference between the two stations is greatest during the pre-construction year of 1999. This suggests that no thermal impact from new construction on the Bruck Property has occurred so far. In light of these results DEP will look into the impact of microclimate on stream temperature readings to allow us to provide better guidance to consultants.

All temperature data is plotted in Figure 51, Figure 52, Figure 53 and Figure 54. These plots show no major change in the temperature regime of Piney Branch between the pre-construction year of 1999 and post-construction year of 2002. Construction on the Bruck property has not caused thermal spiking during storm events, a phenomenon observed when storm water runs off heated surfaces (ie. rooftops, roadways, etc.). Features on the Bruck property which help prevent thermal spiking include: grass swales to convey road runoff to the sand filter/infiltration structure and underground piping from the sand filter to the stream.

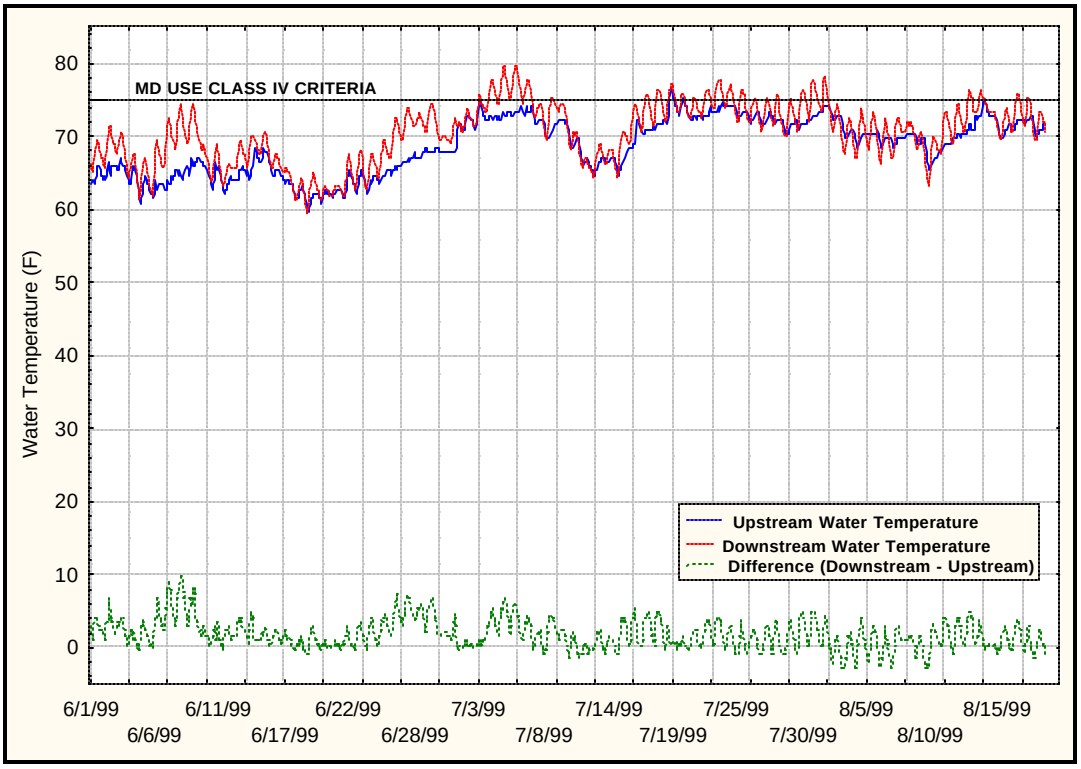

Figure 51 Water Temperature Data From Bruck Property (1999, pre-construction)

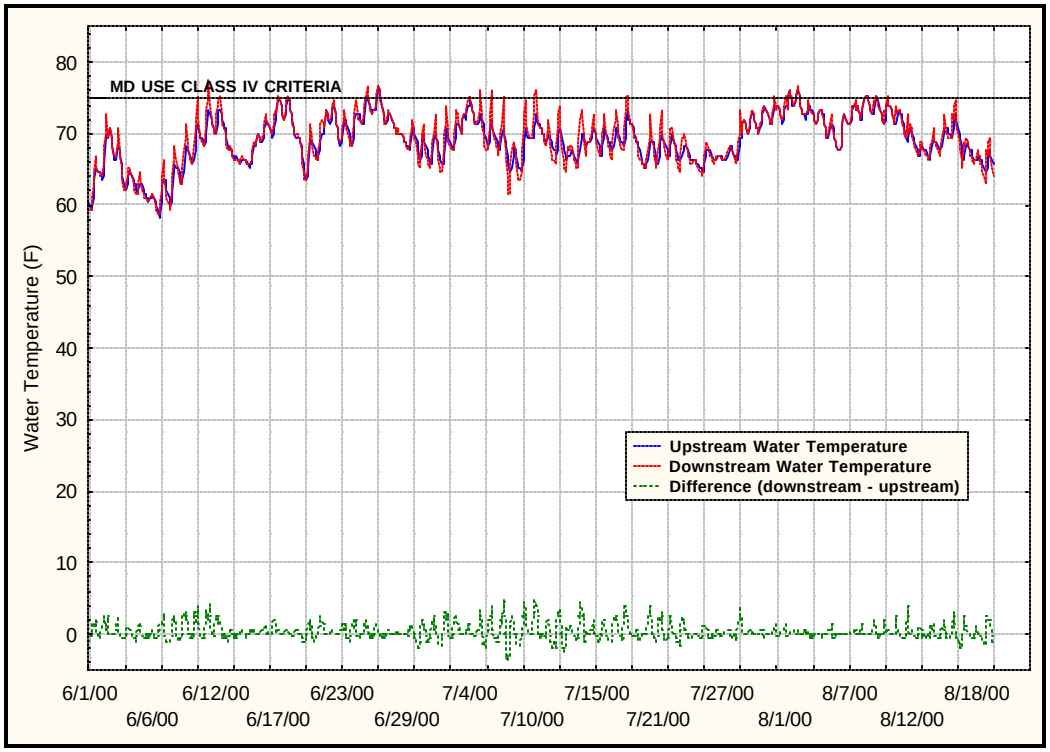

Figure 52 Water Temperature Data From Bruck Property (2000, during-construction)

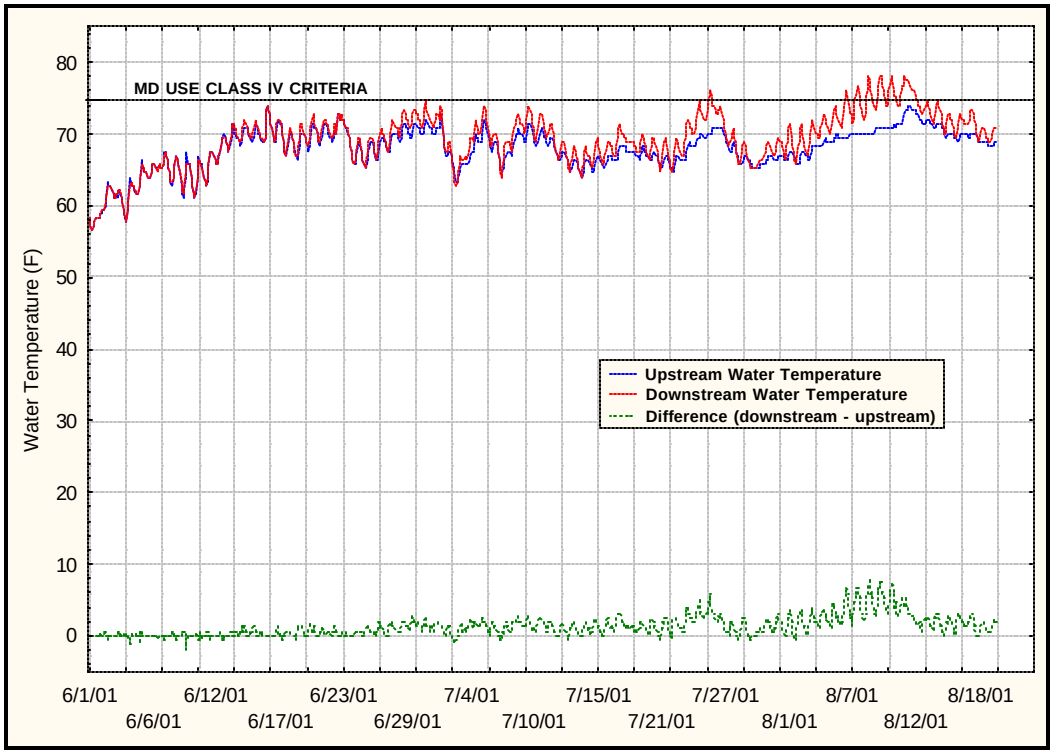

Figure 53 Water Temperature Data From Bruck (2001, post-construction)

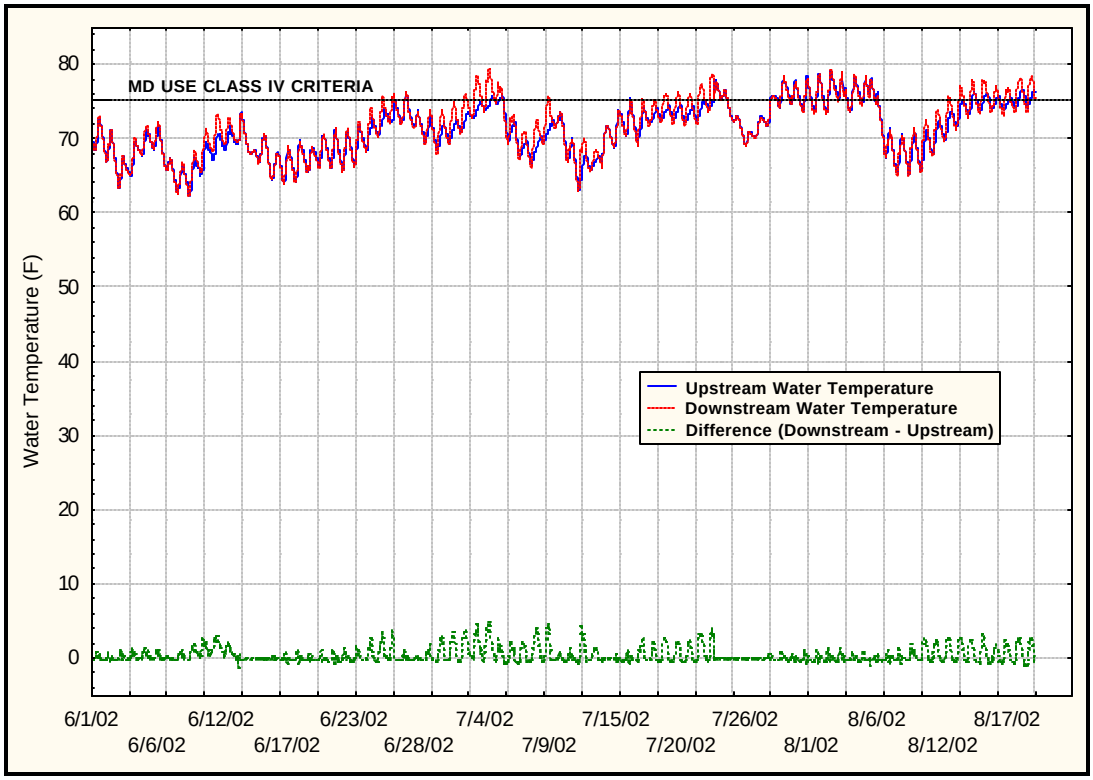

Figure 54 Water Temperature Data From Bruck (2002, post-construction)

Assessment of in-stream habitat has been completed for all years (1999-2002) and indicates no change in habitat structure or quality.

Embeddedness values collected from the Bruck property have generally remained low (0-25%) throughout the pre- and during-construction period of 1999 – 2000. During the post-construction period of 2001-2002 embeddedness values have increased. Since construction is complete at the Bruck property increased sediment in the stream is likely coming from upstream sources.

Peters Property

The Peters Property is a 50 acre parcel of land located on the east side of Glen Mill Road between White Clover Terrace and Unity Lane. The site was developed under the RE-1 cluster option and consists of 26 single-family lots. Stormwater management for the site consists of two dry ponds providing storage for the 2-year storm with a pre-developed release rate. Level spreaders are installed at the dry pond outfalls to reduce water velocity. Water quality control is provided by the use of dual infiltration cells which outfall to the dry ponds. Infiltration cells are sized to treat the first inch of runoff over the contributing impervious area. Pre-treatment of runoff, prior to entering the infiltration cells, is

provided through the use of road side grass swales.

BMP monitoring includes the following (see Figure 55 for monitoring locations):

- Two temperature loggers, one placed at the north end of the property where Piney Branch enters the site. The other placed at the southern end of the property.
- Two embeddedness monitoring stations, one in Piney Branch near the southern end of property the other in Sheeps Run.
- Flow logger placed in Piney Branch downstream of outfall from storm water management facility.

The Final Water Quality Plan calls for stream restoration along stretches of Piney Branch identified as having steep eroding banks.

Construction began in June of 1999 and concluded during the fall of 2001. Pre-construction BMP monitoring began in October of 1998. One full year of pre-construction monitoring was not completed making it difficult to determine changes in stream water temperature as a result of this development. However, the upstream / downstream temperature monitoring locations should allow for analysis of thermal impact from the site.

The period of 5/1/99 – 6/5/99 represents the pre-construction condition for stream temperature. Data from this period show stream temperature to be slightly warmer at the upstream station by 0.7^0 F, on average.

For the during-construction period of 6/6/99 – 9/30/99 stream water temperatures continued to be higher at the upstream station by 0.6^0 F, on average. These results suggest that as Piney Branch flowed through the site, picking up runoff from two sediment ponds, no thermal impact was detected.

Figure 55 Aerial Photo of Peters Property - Construction Completed in Dec. 2001 Photo taken 12/02

Water temperature data submitted for 2000 included un-realistic values and was deemed unreliable (2000 SPA Annual Report). During 2001 the consultant had problems with the downstream temperature logger and no data was obtained from station 2.

Data from 2002 (post-construction) show little difference in average water temperature between station 1 and 2. However, the trend that existed for the pre- and during-construction periods, where water temperature at downstream station 2 was slightly cooler then upstream station 1 did not appear in data from 2002. Upstream station 1 had an average water temperature of 69.8^0 F for the period 5/7/02 – 9/17/02 while station 2 was 70.0^0 F. Maximum water temperature recorded for both the pre- and during-construction periods was higher at upstream station 1. During the post-construction period maximum water temperature was 4.0^0 F warmer at the downstream station 2. Data from 2002 indicate that stream water temperature increased between upstream monitoring station 1 and downstream station 2, a trend not documented during either the pre- or during-construction periods. Possible causes include: 1) hot, dry conditions during 2002 combined with clearing along the stream banks for restoration work resulting in a temporary increase of solar exposure until new planting grow and shade the stream 2) warm water discharge from the stormwater management facility.

Embeddedness monitoring has been completed for one year of the post-construction period at both stations. Results indicate embeddedness at station E1, located in Piney Branch, have generally remained at pre-construction levels. However, at station E2, located in Sheeps Run, embeddedness has increased dramatically (Figure 56). Embeddedness here was rated at 35 – 63 percent for the pre-construction period. Towards the later part of the during-construction period and the post-construction period to date embeddeness went up to 85 – 100 percent. This means rocks on the stream bottom were completely buried under sediment which likely has had a harmful effect on the aquatic life in Sheeps Run. The sediment, most likely, did not come from the Peters property as the site was stabilized in September of 2001 and neither of the two sediment ponds drains to Sheeps Run. The likely source is construction activity on a neighboring site (Snider Property) which has a sediment control pond in the headwater area of Sheeps Run.

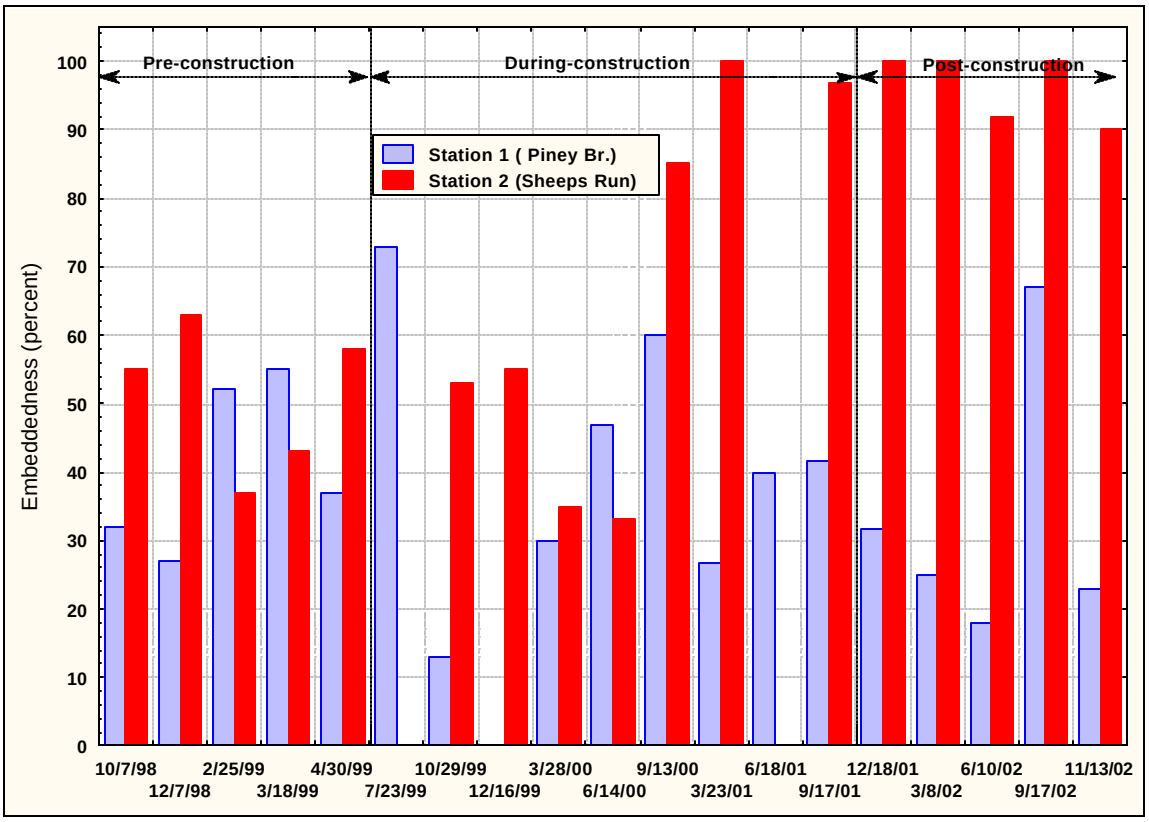

Figure 56 Embeddedness Readings From Peters Property

Continuous stream flow data has been collected from Piney Branch at a location just downstream of the outfall from the stormwater management pond. Stream flow monitoring began in February of 2000. The purpose of this monitoring is to determine if this site changes the stream hydrology by either increasing storm flows or decreasing baseflow. However, DEP had some equipment problems and flow monitoring did not begin until well into the construction period. We have since found a different

supplier of flow monitoring equipment, but the lack of pre-construction data from this site will make it difficult to determine the impact of the site on stream flows. Flow monitoring will still be helpful in evaluating changes to stream hydrology caused by new development further upstream in the Piney Branch watershed. Flow data along with precipitation data from Cabin John Park are used to analyze stream flow response to precipitation. For example, during a storm event on June 7, 2001 stream flow increased to approximately 90 CFS in response to 1.26 inches of rainfall over an eight hour period of time (Figure 57). Baseflow in Piney Branch runs between 1.0 and 3.0 CFS depending on the season.

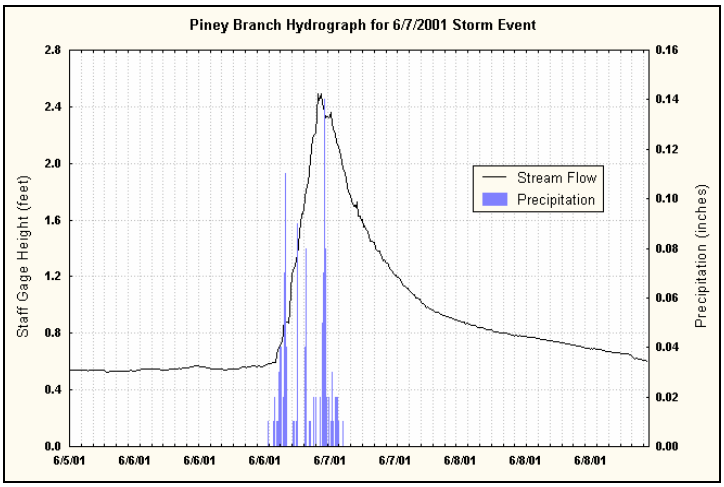

Figure 57 Storm Hydrograph From Piney Branch

On March 26, 2002 a storm event dropped 0.33 inches of rainfall over a two hour period which increased stream flow to approximately 50 CFS (Figure 58). The large increase in flow from such a small storm is due to storm intensity. The storm on 6/7/01 occurred over an eight hour period while the storm on 3/26/02 occurred over a two hour period.

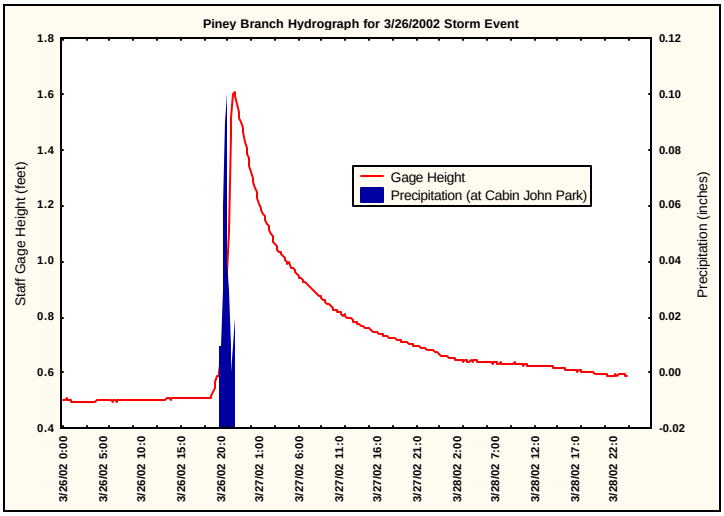

Figure 58 March 26, 2002 Piney Branch Storm Hydrograph

Boverman Property

The Boverman Property is a 13.8 acre parcel of land located near the intersection of Tulip Lane and Glen Mill Road. An unnamed tributary runs through the western side of the property. The tributary flows through a small pond located near the northwestern corner of the property. The site consists of nine single-family lots and associated infrastructure. Storm water control consists of a dry pond providing two-year control and dual sand filters providing quality control of the first inch of runoff over the contributing impervious area. Pre-treatment is provided by vegetated road-side swales before entering the sand filters. A level spreader is installed at the outfall to reduce water velocity from the dry detention pond.

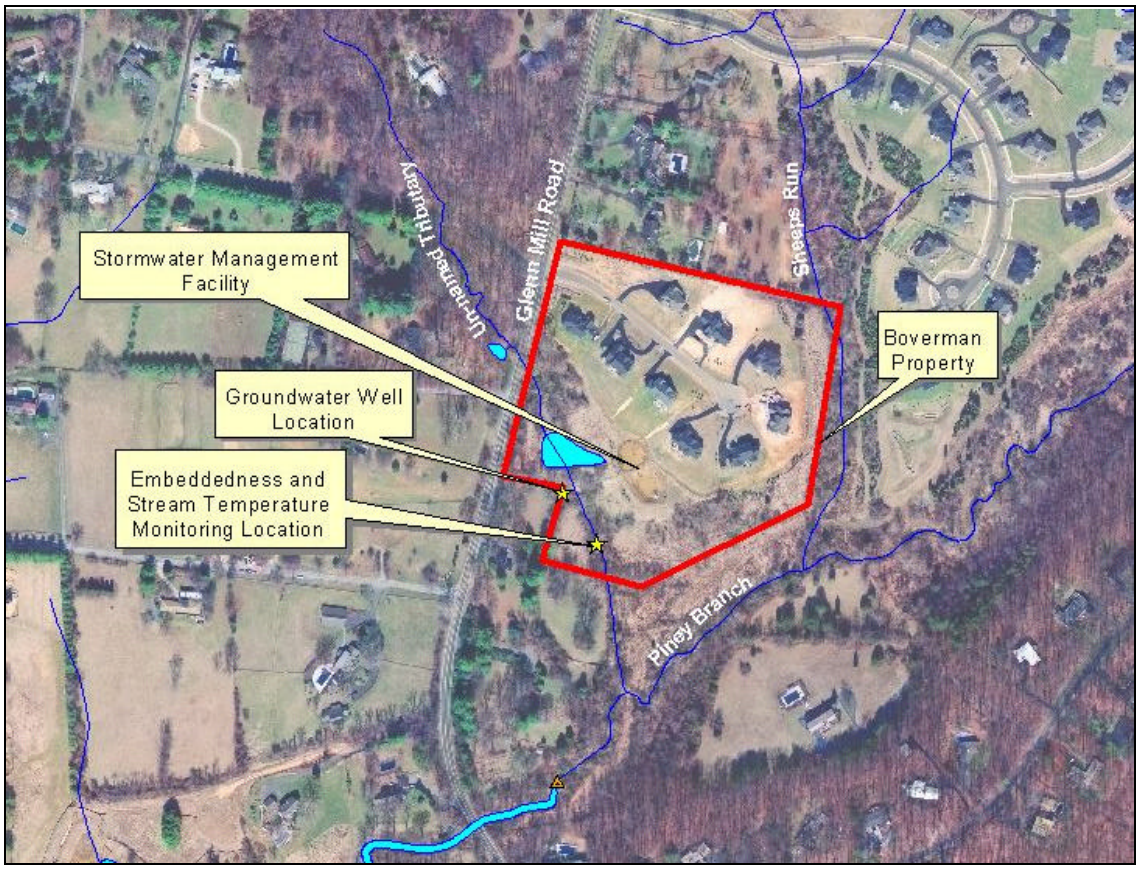

Figure 59 Aerial Photo of Boverman Property. photo taken 12/02

BMP monitoring includes one temperature logger, embeddedness evaluations in the unnamed tributary and one groundwater well from which nutrient concentrations are tested twice annually.

Pre-construction BMP monitoring began in July of 1998. Construction began in July of 1999 and was completed in early 2002. Sediment control was converted to stormwater management in May of 2002. Post-construction monitoring is to be done for three years.

Results of 1998 pre-construction temperature monitoring are presented in Figure 61. Results from the first year of post-construction monitoring are shown in Figure 62. During construction, water temperatures were warmer than during pre-construction. This is surprising because 1998 was a very hot summer and the three following summers were cooler. The warming trend at the site has continued in 2002. 2002 was an even hotter summer than 1998 so this result may be related to weather conditions. However, the water temperatures continue to fluctuate more rapidly than during preconstruction.

Results of embeddedness monitoring are presented in Table 19. Only one pre-construction embeddedness evaluation was submitted. Embeddedness seems to be decreasing at this site. The last observation on 10/2/02 found embeddedness to be very low. The very low observation on 10/2/02 was attributed to drought conditions. The downward trend observed since the beginning of the project is unaccounted for. It may be related to the conversion of the property from agricultural to residential land use. Prior to construction horses were kept on the property and may have increased sediment loads delivered to the stream. The data also indicate that sediment control was successful during construction in keeping soil from disturbed ground out of the stream.

Table 19 Boverman Embeddedness Monitoring Results

Date	Embeddedness (Percent)
06/30/1999 (pre-construction)	75 – 100
12/19/1999 (during-construction)	75 – 100
05/05/2000 (during-construction)	75 – 100
09/28/2000 (during-construction)	50 – 75
05/02/2001 (during-construction)	50 – 75
10/10/2001 (during-construction)	50 – 75
5/20/02 (post-construction)	50-75%
10/2/02 (post-construction)	0-25%

Groundwater well samples are analyzed for nutrients. Results are presented in Table 20 and Figure 60. The data indicate increased concentrations of total phosphorus at the site. These concentrations are low but may be increasing rapidly. The most recent total phosphorus value obtained was 3.6 mg/L however earlier values were much lower. Future monitoring will determine if this trend is continues or if the most recent reading was an isolated value. Nitrate concentrations also increased during construction and have remained at about 2.5 mg/L in spring and 3.5 mg/L in fall of 2001 and 2002. These values are a fraction of the EPA 10 mg/L standard for drinking water. However, the steady influx of groundwater nutrients to the stream could result in nutrient over enrichment and cause negative ecological shifts in the stream.

The location of the groundwater well, which was incorrectly installed on the western side of the small un-named tributary (Figure 59), means that it provides little information on the developed portion of the

site. The increased nutrients are probably coming from the previously developed large lot area to the west. Possible causes include pet waste, fertilizer application or leaking sewage. The sewer line in the area is relatively new and should still be in good repair but could conceivably be leaking. An active or abandoned leaking septic system on the site or in the vicinity could also be contributing nutrients to the local aquifer. DPS has been notified and will watch for other wells in the area that may be exhibiting similar results.

Table 20 Groundwater Nutrient Data From Boverman Property

Date	Total Kjeldahl Nitrogen mg/l	Nitrate Nitrogen mg/l	Nitrite Nitrogen mg/l	Total Phosphorus mg/l
06/30/99 (pre-construction)	<0.1	1.2	<0.1	<0.1
11/03/99 (during-construction)	0.5	NA	NA	0.07
05/05/00 (during-construction)	0.3	1.9	<0.2	0.10
09/28/00 (during-construction)	0.5	2.6	<0.2	0.06
05/02/01 (during-construction)	1.84	2.44	<0.05	0.33
10/10/01 (during-construction)	<0.50	3.65	0.05	0.72
5/20/02 (post-construction)	0.55	2.55	<0.05	0.46
10/2/02 (post-construction)	0.55	3.56	<0.05	3.6

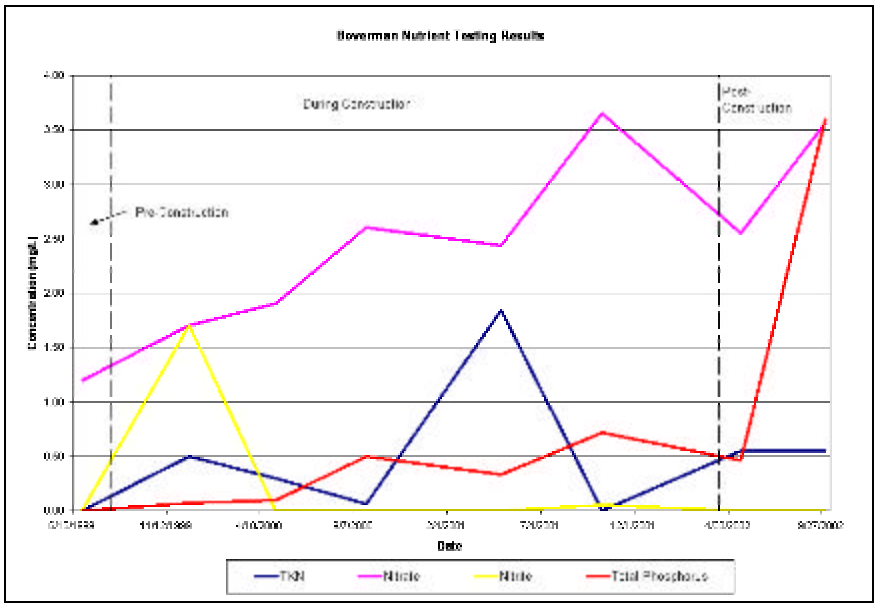

Figure 60 Groundwater Nutrient Concentrations

In summary, BMP monitoring at the Boverman Property to date has provided the following results:

- The greater daily fluctuation in water temperatures observed during-construction has continued into the post-construction phase of monitoring. This may be because the temperature loggers are reading air temperatures but the consultant has not identified this.
- Embeddedness values have decreased throughout construction and into post-construction.
- Groundwater nitrate concentrations have steadily increased during construction.
- Groundwater phosphorus values increased slightly during construction and have spiked up sharply during post-construction.

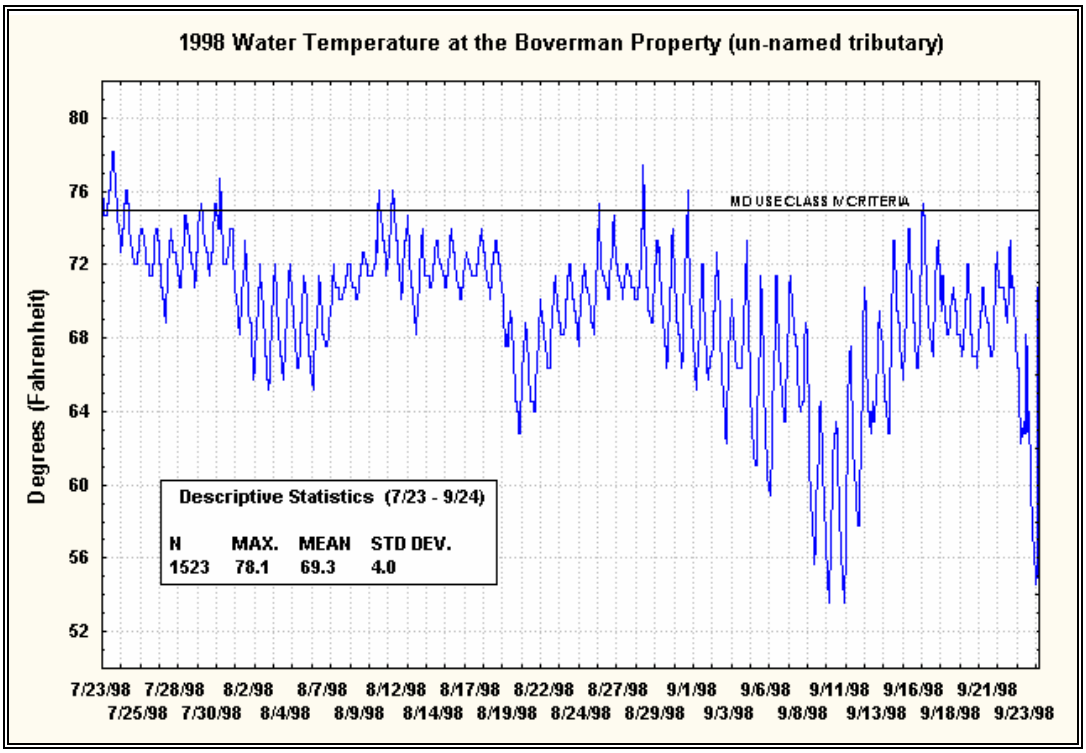

Figure 61 1998 Boverman Water Temperatures (Pre-construction)

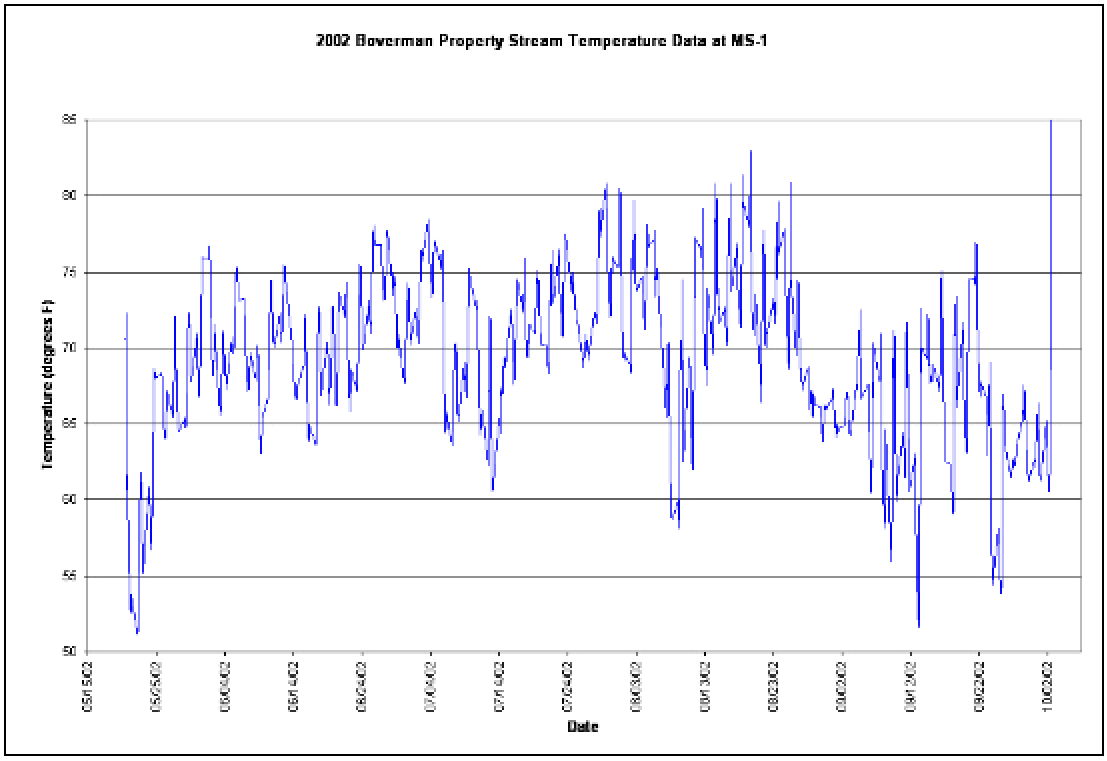

Figure 62 2002 Boverman Water Temperatures (Post-construction)

Cavanaugh Property

BMP monitoring at the Cavanaugh Property includes embeddedness readings at one station, three stream temperature loggers and two groundwater wells. Monitoring of the two groundwater wells was stopped prematurely by the developer in May of 2001. DEP has notified the developer that groundwater monitoring needs to resume.

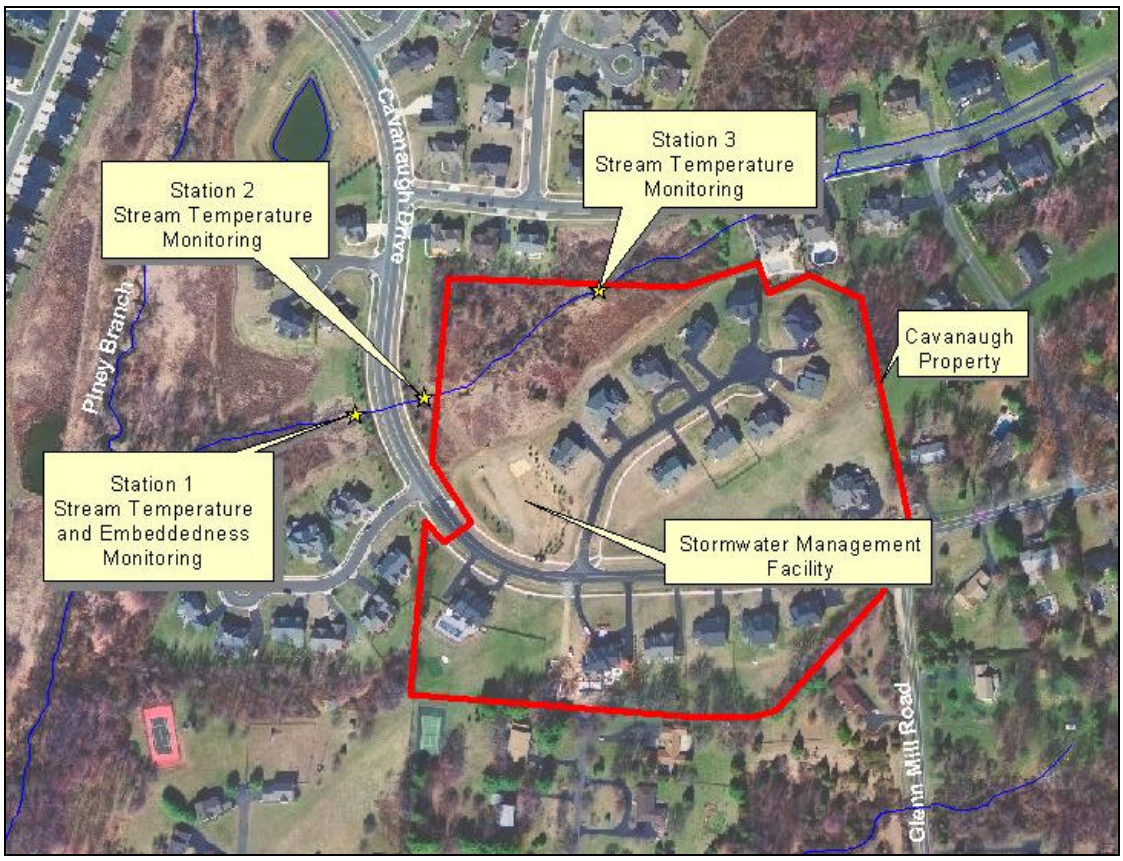

Figure 63 Aerial Photo of Cavanaugh Property (taken 12/02)

Pre-construction monitoring was conducted from July 1998 through April 1999. Construction phase monitoring began in June 1999 and ended in March of 2002.

Unfortunately, a beaver dam was constructed during 2001 at the site which interfered with data collection at downstream station 1. Embeddedness values may have been affected and the station 1 temperature logger could not be recovered in 2001.

Embeddedness values are presented in Figure 64 below. Embeddedness values averaged 63.1 % prior to construction. In the early stages of construction higher levels of embeddedness were observed. Embeddedness values averaged 83.0% from June 1999 until December 1999. At least once during this

period, fresh sediment deposits were noted in the stream when embeddedness readings were being taken. Beginning in 2000, embeddedness values were more comparable to values observed prior to construction. From March 2000 through November of 2001 embeddedness values averaged 54.3%. These data indicate that the Cavanaugh BMPs were not able to stop sediment from leaving the site and affecting the stream in the early stages of construction when large areas are disturbed. Later on in the construction process, as portions of the site were stabilized and grading activity diminished, the site had a lesser impact on stream embeddedness values. During the post-construction period to date embeddedness values have remained at 100%. This means rocks and gravel on the stream bottom are completely covered with sediment. The source of sediment is the beaver dam constructed just upstream which was washed out in a storm causing sediments, trapped by the dam, to flush downstream.

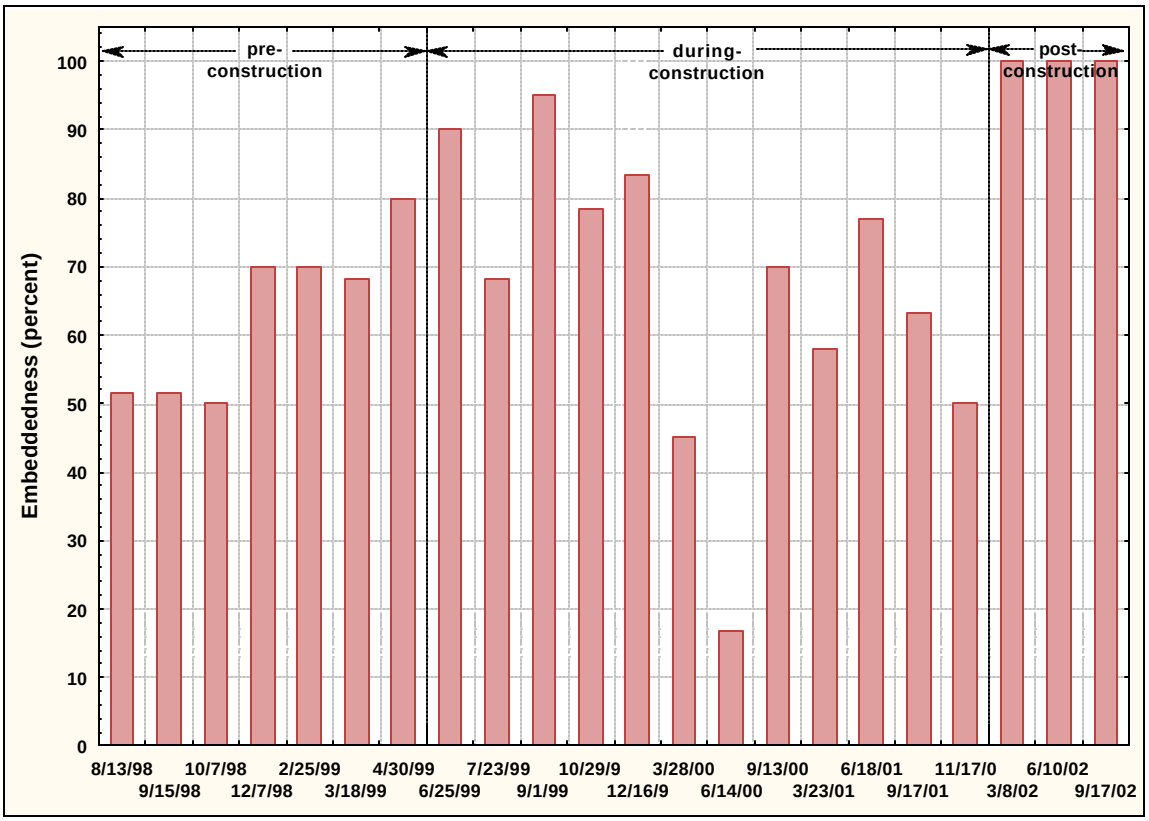

Figure 64 Embeddedness Monitoring Results From Cavanaugh Property

Stream temperature data collected from all three monitoring stations are summarized in Table 21. Data are not available from station 1 during 2001 due to the construction of a beaver dam on top of the temperature recording instrument.

During the preconstruction year of 1998 median stream temperatures increased 3.33 degrees Fahrenheit across the site in 1998. Dulles Airport summer air temperatures were 1.6 degrees warmer

than normal in 1998. 1999 was also a hot summer and the median stream temperature increased 4.5 degrees Fahrenheit across the site. 2000 was a cool summer and median temperature increased by only 1.01 degrees across the site. During 2002, the first post-construction year, median temperature increased by 3.5 degrees between stations 1 and 3. 2002 was a very hot summer. Dulles Airport summer air temperatures were 2.1 degrees warmer than normal in 2002. This indicates that during the first post-construction year stream temperature regime is comparable to pre-construction after accounting for air temperature differences. Development of the site does not appear to have cause stream temperatures to increase.

Table 21 Median Stream Temperatures (Fahrenheit) From Cavanaugh Property

		Station #1 (Downstream Station)	Station #2 (Middle Station)	Station #3 (Upstream Station)	Temperature Difference (Sta 1 - Sta 3)	Dulles Airport Air Temperature Departure From Normal
7/20/98 – 9/13/98	**Pre-construction**	66.78	64.99	63.45	+3.33	+1.6
7/20/99 – 9/13/99	**During-construction**	68.52	66.74	64.02	+4.50	+0.8
7/20/00 – 9/13/00		66.27	65.57	64.45	+1.82	-1.6
7/20/01 – 9/13/01		Lost	65.57	64.81	N/A	-0.5
7/20/02 – 9/13/02	**Post-construction**	68.58	66.90	65.08	+3.50	+2.1

4.3.5 Summary of Stream Monitoring in Piney Branch

Baseline stream monitoring began in the spring of 1995 at six stations along Piney Branch. Four stations were added in 1997 to provide data immediately downstream of development sites. Benthic macroinvertebrates were sampled at all ten stations in 2002 and fish were sampled from five stations.

DEP completed two rounds of nutrient sampling at thirty nine (39) locations throughout the Piney Branch watershed during 2002. The purpose was to identify areas in the watershed contributing high levels of nutrients.

Three temperature loggers were deployed in Piney Branch during the summer of 2002. The purpose was to continue evaluating stream water temperatures in the mainstem in comparison to the Western tributary, which has been used as a control.

4.3.5.a Biological Monitoring

Biological monitoring results are used to calculate Index of Biological Integrity (IBI) scores. IBI scores from 2002 for both fish and benthic macroinvertebrates are presented in Figure 65 and Figure 66. Fish IBI scores indicate little or no change in the fish community at four of the five stations sampled during 2002. All four stations exhibiting little change are located along the Piney Branch mainstem. The one station showing significant change is WBPB101, located in the Western tributary where IBI dropped from good to fair. Prior to 2002 IBI scores from WBPB101 have remained in the excellent/good range during the period of 1995 - 2001. Changes in the fish community that account for this include higher proportion of tolerant fish species (e.g. Blacknose dace) and a drop in the number of intolerant, riffle/benthic species (e.g. Potomac sculpin and Blue Ridge sculpin). The cause of these changes is likely the drought which reduced flow in the Western tributary to a trickle. Low flow conditions typically have more impact on species that inhabit the riffle portions of streams because these areas, which are shallow to begin with, lose more available habitat. Pools, on the other hand, are less affected by low flow conditions and retain most of their available habitat. Fish species that can utilize pool habitat have a better chance of surviving the drought. Although stream flow in the mainstem of Piney Branch was also greatly reduced during 2002, the riffle/benthic species likely had more habitat available simply due to the larger drainage area and stream size.

Overall condition of the fish community in upper portions of Piney Branch at stations WBPB201, WBPB202 and WBPB203A continues to rate in the poor/fair range. The one station in lower Piney Branch sampled for fish in 2002 (WBPB205) was rated good.

Results of benthic macroinvertebrate monitoring from 2002 presented in Figure 66 show IBI scores are higher then 2001 at all stations except WBPB204B and WBPB101. This is somewhat encouraging and may be due to favorable flow conditions during the year prior to sampling in spring of 2002. The occurrence of flooding events can be enough of a disturbance to the stream bottom to impact the

benthic macroinvertebrate community. The last bankfull flow event prior to sampling in April of 2002 was in August of 2001.

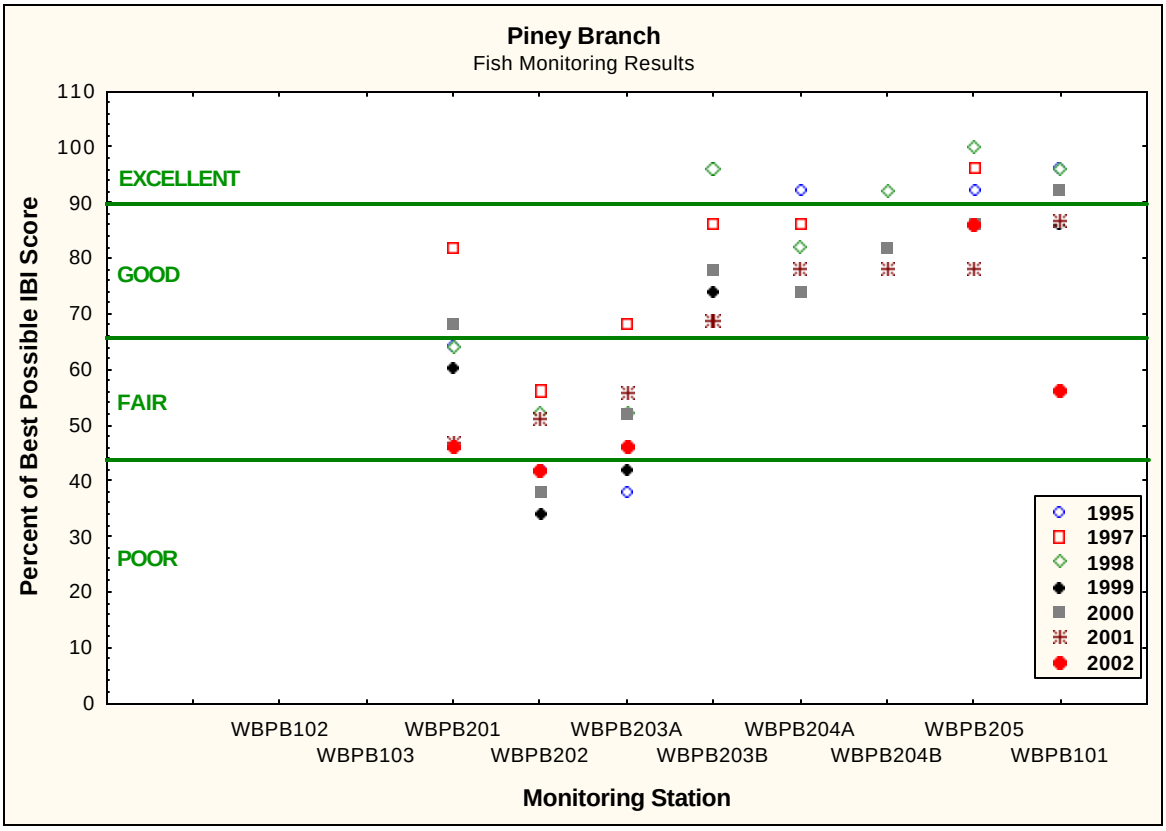

Figure 65 Results of Fish Monitoring In Piney Branch

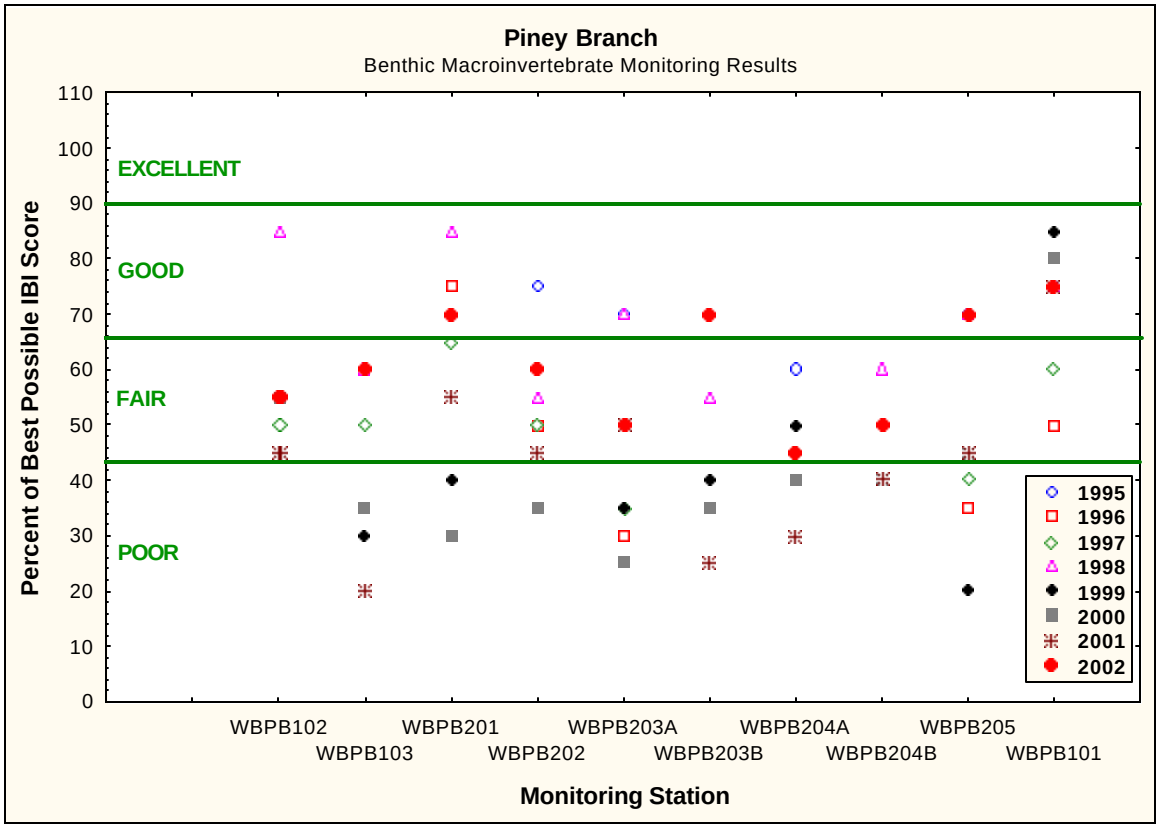

Figure 66 Results of Benthic Macroinvertebrate Monitoring In Piney Branch

4.3.5.b Habitat Monitoring

Results of all rapid habitat assessments done in Piney Branch are presented in Figure 67. Median habitat scores from all stations have remained in the sub-optimal range although several individual values since 1995 have been near the lower threshold of the sub-optimal range. This means that overall condition of stream habitat is adequate to support a diverse biological community but that some habitat impairment is present.

Results of habitat assessment completed during 2002 at station WBPB103 is slightly lower then in previous years. Analysis of individual parameters that make up the overall habitat assessment reveals no one parameter explains the lower score. Because observable changes in channel morphology are generally slow, quantitative monitoring has been scaled back in frequency. We did very little quantitative monitoring in Piney Branch SPA in 2002.

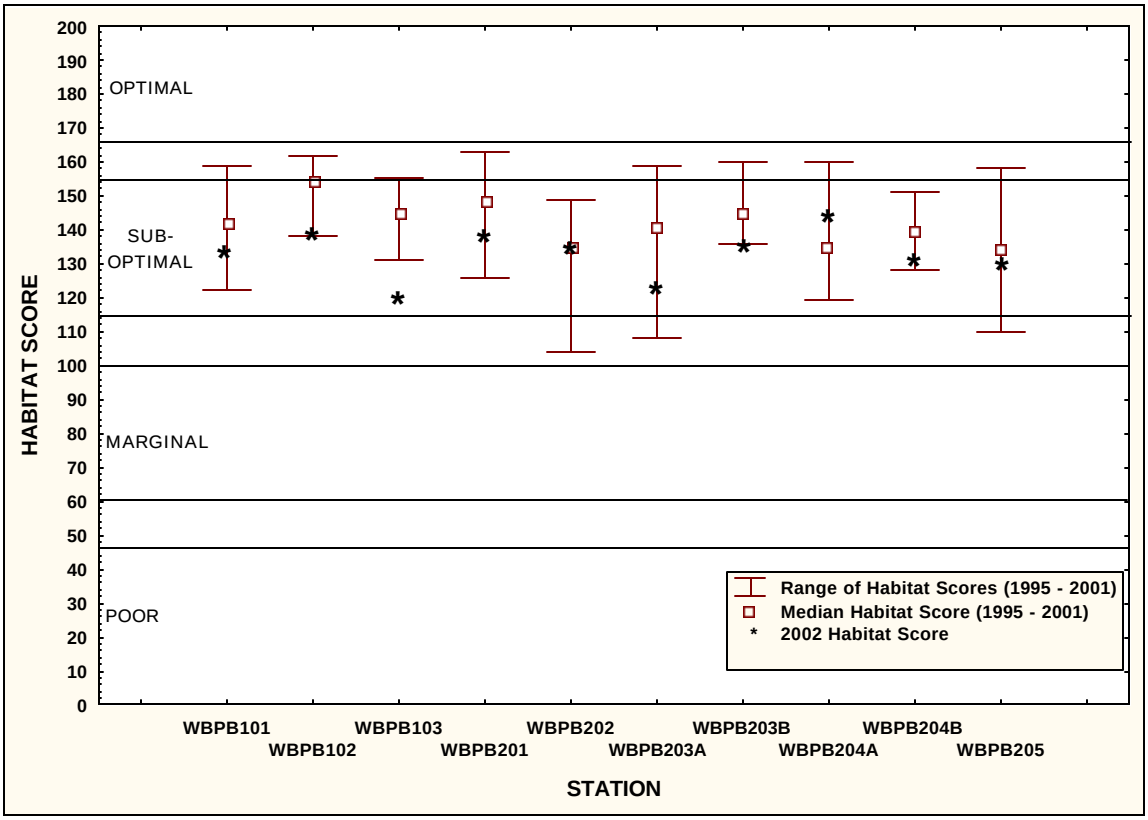

Figure 67 Results of Rapid Habitat Assessments In Piney Branch

4.3.5.c Nutrient Study

Although results of benthic macroinvertebrate monitoring indicate some improvement in community health, work continued during 2002 to identify source(s) of impairment to water quality in the Piney Branch SPA. During 2001 DEP conducted a temperature study to determine if stormwater wet ponds constructed on the Willows of Potomac and Piney Glen Village developments were causing thermal impacts in the mainstem of Piney Branch. The conclusion was that the wet ponds were not causing thermal impacts (SPA Annual Report for 2001, 7/02). As a next step DEP developed and conducted a nutrient study during 2002 with the goal of isolating areas in the watershed contributing high levels of nutrients.

Background

Since 1999 DEP has noted what appears to be an increase in algae growth within the stream. In 2001, hydrolabs were deployed over several days to look at diurnal patterns of dissolved oxygen (DO) concentrations in the stream and the degree at which algae growth is affecting these patterns. Results show a difference in diurnal pattern between the mainstem of Piney Branch and the Western tributary

(SPA Annual Report for 2001, 7/02). Fluctuation of DO between day and night was greater in the mainstem (high algae growth) then the Western tributary (low algea growth). During the night DO in the mainstem was observed to drop close to levels considered stressful to aquatic life (<5.0 mg/l). The cause of greater diurnal fluctuation of DO in the mainstem is believed to be higher algae growth. This is because algae, like any other plant, produces oxygen during the daylight hours and consumes oxygen during night time hours. Therefore more abundant algae growth results in greater DO fluctuation between day and night. The apparent increase of algea production in the mainstem of Piney Branch could be from increased nutrient inputs.

Study Design

The study was designed to get a 'snapshot' of nutrient concentrations from throughout Piney Branch during baseflow condition when stream flow originates mainly from groundwater input.
Nutrient parameters analyzed were nitrate and ortho-phosphate. CHEMetrics field test kits were used for sample analysis. Detection limits on the field test kits were 0.1 ppm for nitrate and 0.05 ppm for ortho-phosphate. Eight (8) samples were sent to the WSSC lab for comparison with and validation of field test kits. Thirty nine (39) locations throughout Piney Branch were selected to isolate most tributaries (Figure 68). Two rounds of sampling were completed, one on 3/7/02 the other on 8/15/02.

Results

Results of both sampling rounds are presented in Table 25. Many tributaries were dry during the second round of sampling in August because of the drought. In the case of dry tributaries, samples were taken at only one of the upstream/downstream locations in the mainstem. In general, nitrate and ortho-phosphate concentration was found to be low throughout Piney Branch. Nitrate concentration was found to be somewhat higher in two tributaries: 1) PBN38 located in lower Piney Branch had a nitrate concentration of 3.5 mg/l during the 3/7/02 sampling and 2) PBN13 located within the middle portion of Piney Branch had a nitrate concentration of 3.0 mg/l during the 8/15/02 sampling. The PBN38 tributary is located at the bottom of the watershed and therefore would not contribute to the algae growth upstream. The PBN13 tributary was found to have a high nitrate concentration only during the August sampling. Higher nitrate concentrations in either of these two tributaries had no apparent effect on concentrations in the Piney Branch mainstem.

Ortho-phosphate concentrations were below detection limit of the field test kit at all locations sampled during both rounds of sampling. Six of the seven samples analyzed by the WSSC lab in August were higher then they were in March. This may be due to greater dilution during the spring when baseflow was higher. Nitrate concentrations were higher during the spring for all eight samples analyzed by the WSSC lab.

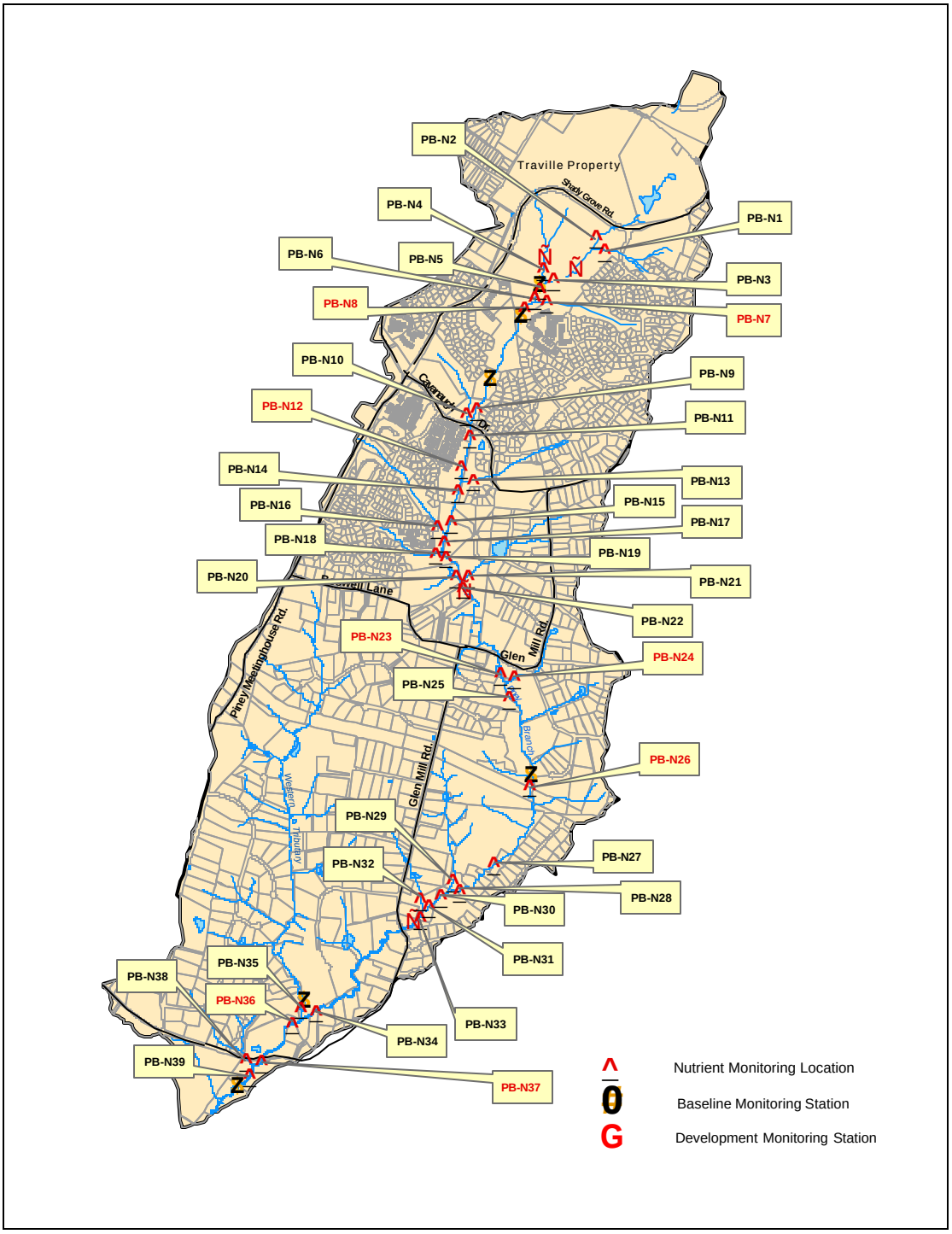

Figure 68 Nutrient Monitoring Sites - Samples Labeled in Red Were Analyzed by WSSC Lab

Table 25 Nutrient Monitoring Results From Piney Branch

	March 7, 2002				August 15, 2002			
Location	**Nitrate (mg/l)** Field Test Kit Results	**Nitrate (mg/l)** Lab Results	**Ortho-P (mg/l)** Field Test Kit Results	**Ortho-P (mg/l)** Lab Results	**Nitrate (mg/l)** Field Test Kit Results	**Nitrate (mg/l)** Lab Results	**Ortho-P (mg/l)** Field Test Kit Results	**Ortho-P (mg/l)** Lab Results
PB-N1	0.1		< 0.05					
PB-N2	0.7		< 0.05		0.3		< 0.05	
PB-N3	1.0		< 0.05		1.0		< 0.05	
PB-N4	1.5		< 0.05		1.5		< 0.05	
PB-N5	1.0		< 0.05		1.0		< 0.05	
PB-N6	1.0		< 0.05		1.0		< 0.05	
PB-N7	1.0	1.095	< 0.05	0.008	0.5	0.491	< 0.05	0.067
PB-N8	1.0	1.366	< 0.05	0.007	1.0	1.046	< 0.05	0.011
PB-N9	0.9		< 0.05		1.0		< 0.05	
PB-N10	0.4		< 0.05		1.8		< 0.05	
PB-N11	1.0		< 0.05		1.0		< 0.05	
PB-N12	1.0	1.053	< 0.05	0.010	1.0	1.039	< 0.05	0.010
PB-N13	1.0		< 0.05		3.0		< 0.05	
PB-N14	1.0		< 0.05		1.0		< 0.05	
PB-N15	1.0		< 0.05		1.0		< 0.05	
PB-N16	0.9		< 0.05		DRY	DRY	DRY	DRY
PB-N17	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N18	1.0		< 0.05		DRY	DRY	DRY	DRY
PB-N19	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N20	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N21	1.0		< 0.05		DRY	DRY	DRY	DRY
PB-N22	1.0		< 0.05		0.9		< 0.05	
PB-N23	1.9	1.201	< 0.05	0.014	0.9	0.617	< 0.05	0.006
PB-N24	0.0	0.019	< 0.05	0.007	DRY	DRY	DRY	DRY
PB-N25	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N26	1.0	1.057	< 0.05	0.003	0.4	0.363	< 0.05	0.007
PB-N27	1.0		< 0.05		0.3		< 0.05	
PB-N28	1.0		< 0.05		0.3		< 0.05	
PB-N29	1.0		< 0.05		DRY	DRY	DRY	DRY
PB-N30	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N31	1.0		< 0.05		0.3		< 0.05	
PB-N32	1.5		< 0.05		DRY	DRY	DRY	DRY
PB-N33	1.0		< 0.05		0.3		< 0.05	
PB-N34	1.0		< 0.05		N/S	N/S	N/S	N/S
PB-N35	1.5		< 0.05		N/S	N/S	N/S	N/S
PB-N36	1.0	1.296	< 0.05	0.003	0.9	0.618	< 0.05	0.009
PB-N37	1.0	1.278	< 0.05	0.003	0.8	0.608	< 0.05	0.010
PB-N38	3.3				DRY	DRY	DRY	DRY
PB-N39	1.0		< 0.05		N/S	N/S	N/S	N/S

Conclusion

Except for two samples, nutrient concentrations (nitrate and ortho-P) were found to be low during both rounds of sampling. The two tributaries that did have higher nitrate concentrations were found in the middle and lower portions of the watershed and therefore would not explain high rates of algae growth in the upper portions. The results of this study do not eliminate the possibility that nutrient input to the stream from groundwater sources has increased in recent years. It is possible that the influx of nutrients to the stream via groundwater has increased over the last several years but that the nutrients are taken up by the algae and therefore are not detected. Groundwater monitoring on the Boverman property (located in lower portion of Piney Branch watershed) has shown concentrations of nitrate and total phosphorus have increased between June of 1999 and October of 2002. There is no way to know if this same trend has been occurring elsewhere in the watershed.

Results of this study did not isolate any 'hot spots' in the watershed where nutrients were found to be high during both rounds of sampling.

4.3.5.d Temperature Monitoring

Temperature loggers were deployed at three locations in Piney Branch during the summer of 2002, WBPB202, WBPB204B and WBPB101. The logger at WBPB204B malfunctioned. Results from the other two loggers are presented in (Figure 69).

Water temperature at WBPB101 was higher during 2002 then any other year monitored since 1996. Warmer water temperature was observed at all of the SPA's and is the result of drought conditions and hot weather experienced throughout the region.

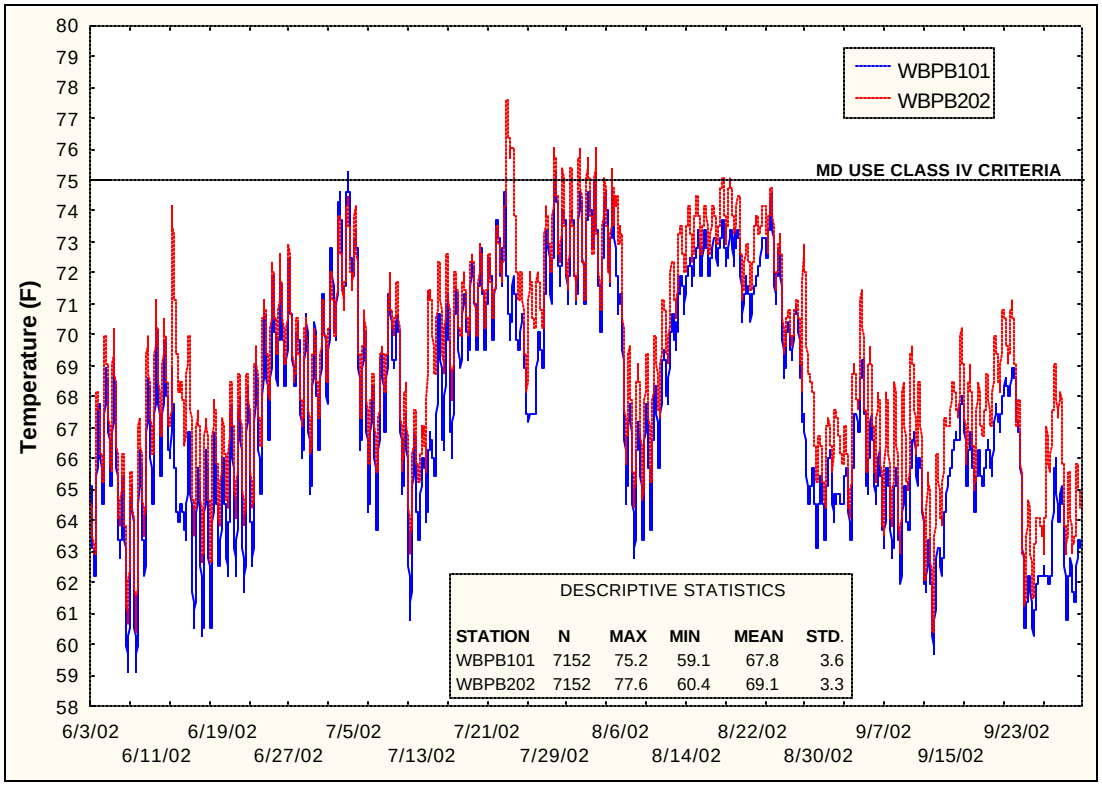

Figure 69 Stream Water Temperature Data From Piney Branch